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Johnstone

MEDICAL ESSAYS

AND

OBSERVATIONS.

[PRICE SEVEN SHILLINGS AND SIX-PENCE.]

MEDICAL

ESSAYS AND OBSERVATIONS,

WITH DISQUISITIONS RELATING TO

THE NERVOUS SYSTEM.

By JAMES JOHNSTONE, M.D.
PHYSICIAN IN WORCESTER.

Simplex Sigillùm Veri.——*Boerhaave.*

AND,

AN ESSAY

ON MINERAL POISONS,

By JOHN JOHNSTONE, M. B.
PHYSICIAN IN BIRMINGHAM:
OF MERTON-COLLEGE, OXFORD; FEL. OF THE ROYAL MED. SOC. EDIN. COR.
MEM. OF THE MED. SOC. LON. AND LATE PHYS. TO THE GEN. INFIR. WORC.

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I.

AN

ESSAY

ON THE

GANGLIONS OF THE NERVES,

SHOWING THEIR USE IN THE VITAL AND OTHER INVOLUNTARY MOTIONS OF ANIMALS.

REPUBLISHED WITH ADDITIONS.

IN experimental philoſophy, propoſitions collected from the phœnomena by induction, are to be deemed, notwithſtanding contrary hypotheſis, either accurately, or very nearly true, till other phœnomena occur, by which they may be rendered either more accurate, or liable to exceptions.

Sir Iſaac Newton's fourth rule of Philoſophiſing Pract. Math.

THE works of GOD are ſo worthy of their author, that beſide the impreſſes of his wiſdom and goodneſs left, as it were, upon their ſurfaces, there are a great many more curious and excellent tokens and effects of Divine artifice, in the hidden and innermoſt receſſes of them. And theſe are not to be diſcovered by the ſlight glances of the lazy and the ignorant; but require the moſt attentive and prying inſpection of curious and well-qualified minds. —— *Boyle Chr. Virtuoſo.*

ADVER-

ADVERTISEMENT.

THE firſt ſketches of this Eſſay were, many years ſince, put into the hands of Dr. *Lyttelton*, biſhop of Carliſle, and preſident of the Antiquary Society; who, with all the qualities that endeared the friend and adorned the gentleman, had that affection to learning and ſcience, which has long diſtinguiſhed his family.

His Lordſhip preſented to the Royal Society that paper, which, with the ſupplements to it, were firſt publiſhed in the 54th, 57th, and 60th volumes of the Philoſophical Tranſactions. If they appear in this republication,

publication, with any new advantages, they are owing to the connection of materials, and, to the friendly and candid remarks of very diſtinguiſhed judges of this ſubject; which, however, appearing inſufficient to overturn this doctrine, led me to make ſuch additions, and to try ſuch experiments, as ſeem to clear up the objections made to it, and illuſtrate and enforce the concluſion with ſuch preponderance of argument and evidence, as will probably hereafter entitle it to conſideration in the phyſiology of the nerves, and involuntary motions of animals; and may encourage ſtudents in anatomy and medicine, to ſupply my deficiencies, and become improvers of this ſubject, and in the knowledge of the nervous ſyſtem at large, which is every where an open and inviting field for the exerciſe of induſtry and genius.

No one can be more ſenſible than I am,

that, with very inadequate qualifications, I have undertaken a moſt difficult taſk. The utmoſt I flatter myſelf to have done, is to have opened a path, which may be beaten by others, to the inſtruction of mankind.

Indulging the perſuaſion, that I have traced an outline of a new branch of phyſiological and medical ſcience, I ſubmit this Eſſay again to the public eye; and, now take leave of the ſubject, in the words of *Seneca*: " Multum adhuc reſtat operis, mul-" tumque reſtabit; nec ulli nato poſt mille " ſecula præcludetur occaſio aliquid adhuc " adjiciendi."*

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*THE additions to this republication of the firſt Eſſay, are chiefly in the notes, under p. 4—13—28, and ſeq. In the text, from p. 30—37; and fifth and ſixth Sections.

The papers not before publiſhed, and wholly new, in this volume, are, art. 2—7—8—9—12, and the valuable Eſſay on Mineral Poiſons.

From the induſtry and genius of the author of this Eſſay, the learned world has more to expect: provided he reſtrains the ardour of his purſuits within the bounds required by a delicate conſtitution.

In eſtimating the powers and action of different ſubſtances employed in medicine, it is highly uſeful to aſcertain the extreme miſchiefs they are capable of producing, in order to guard againſt them.

ERRATA.

NOTE, p. 5.—*for* 117 *read* ſect. 7. P. 11.—Deviſe's—Diviſes. P. 12. l. 11—Pericardiam—Pericardium. P. 30. l. 46—Saturnian—Saturnine. P. 31. l. 1—Valti—Valli. P. 131. l. 1—Pleuro-pneumies—Pleuropneumonies. P. 114—Canium—Cranium P. 159, 160—*read* Hyoſcyamus Ib. l. 12—Deliterious—Deleterious. P. 166 l. 3—*read* Deprived. P. 224. l. 6—Mental—Rural. P. 226, &c.—Bilioſe—Bilious. P. 229—T. Sacra—Sacræ. P. 231. l. 17—Pericardium—Peritoneum. P 153. l. 8—*after* vinegar: *add*—and in the intervals an equal quantity of volatile tincture of guaiacum in coffee. P. 176—*after* extinguiſh life, *(ſee Proſper alpini de medicina ægypt.* l. 4. p. 119.) P. 278, l. 3—*after* Royal, *add* Medical. p. 234, l. 17—dele period.

AN

ESSAY

ON THE USE OF THE

GANGLIONS OF THE NERVES.

SECTION. I.

The uſe of the Ganglions of the nerves not hitherto aſcertained: Introductory Propoſitions concerning the nerves in general.

THE Ganglions of the intercoſtal, or great Sympathetic Nerves, deſcribed by *Fallopius*,* are oblong, and very hard knotty bodies; the uſes of which have not been ſatisfactorily aſcertained by any one. From ſome vague reſemblance which anatomiſts fancied they found in theſe knots, to thoſe in the roots of ſome plants and branches of

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* The word Ganglion, is a Greek root, found in *Celſus* and *Galen*, and preſerved in modern books of ſurgery; it was at firſt uſed as the name of certain hard tumors, ſeated on the ligaments or ſinews. The reſemblance of the ganglions of the nerves, real or fancied, to theſe morbid tumors, was probably the occaſion of their being called, by *Fallopius*, indiſcriminately, Ganglia, as well as corpora olivaria & plexus. Theſe terms, and thoſe of conſociation and aſſociation, of nerves, were uſed by ſucceeding anatomiſts,

trees, it was ſuppoſed their uſe conſiſted in giving ſome additional *firmneſs* to the nerves: but this has not often been repeated by anatomical writers after *Willis* and *Vieuſſens*. Few anatomiſts have, indeed, examined this ſubject, with that attention and accuracy, with which it is diſcuſſed by the learned *J. M. Lanciſi*. He imagined the Ganglions to be muſcles *ſui generis*, and, like other muſcles, capable of contractions; by which, he thought, the nervous ſpirits were accelerated and impelled with ſuch additional forces as are, by him, ſuppoſed neceſſary to the production of motions in muſcles ſubject to the will: and, in order to give an idea of the ſtructure of all other Ganglia, he particularly deſcribes and delineates that of the firſt cervical Ganglion.*

This theory has the misfortune to be erroneous in

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as ſynonimous, till about the beginning of this century: that the knots peculiar to certain nerves, I think, for the moſt part, are now only called Ganglia. The other unions of the nerves, without intumeſcence or hardneſs, are called Plexus; and in this diſtinct ſenſe we ſhall uſe theſe words throughout this Eſſay.

" Corpora olivaria aliquando concreſcunt, incerto tamen numero, quæ
" nulla alia *ſubſtantia* quam *nervea* & quaſi in *callum* concreſcente conſtant.—
" Cum ego primus talem nervorum copulam obſervarim, primus quoque
" nomine impoſito plexum appellabo a quo plexu plures nervi ad cordis ba-
" ſim feruntur." *Fallop.* Obſ. Anat. edit. cum oper. *Veſal.* p. 737. The ingenious Dr. *Martin* concurs with *Veſalius* in diminiſhing the pretenſions of *Fallopius* as the firſt diſcoverer of the ganglions of the nerves, and in giving that honour to *Galen*, See Comment. in *Euſt.* Tab. p. 208.

* See *Lanciſi*'s Diſſertation publiſhed in the Adverſaria Anatomica of *Morgagni*.

in its foundation; for that moſt accurate and ſkilful inquirer into ſubjects of this nature, the illuſtrious Baron *Haller*, and other celebrated anatomiſts, have not been able to diſcover this muſcular apparatus in the *firſt cervical Ganglion*,* or in any other *Ganglion*. The coverings and ſubſtance of ganglia, with the appearance, have all the firmneſs of ligamentous ſubſtance, but are incapable of that extention and contraction which *muſcular fibres*, *ever elaſtic*, always allow of.

Ganglions beſides, inſtead of being inſtruments ſubſervient to the will, are almoſt peculiar to nerves, diſtributed to parts, the motions of which are totally involuntary. And our author muſt have been greatly miſled by his hypotheſis not to obſerve this ſtriking circumſtance. The theory, which prevailed in his time and country, of the action of the *dura mater* upon the brain, now exploded, might lead this great man more entirely to believe an analogous muſcular power in Ganglions. But the brain needs no muſcular force to impreſs motion upon the animal ſpirits; *the power preſiding there is of a different kind:* nor, granting Ganglions to be, as is ingeniouſly conjectured by *Lanciſi* and *Winſlow*, ſubſidiary brains, or analogous to the brain in their uſes, will they need any ſuch muſcular apparatus and force. A power, in

fine,

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* *Haller*'s Elem. Phyſiol. Human. Tom. iv. p. 203.

fine, abſurd no leſs than imaginary, as it ſuppoſes the force of muſcles of the greateſt exertion and effect, to be derived from thoſe of leaſt bulk and ſtrength: (which muſt, *cæteris paribus*, act in proportion to the quantity of muſcular fibres,) and would be a ſingle inſtance of a mechanical force producing another infinitely greater than itſelf.

The accurate *Winſlow* reckons the Ganglions, eſpecially thoſe of the ſpinal nerves, to be ſo many diſperſed origins of the great ſympathetic nerves; but goes no farther in pointing out their uſe. The late profeſſor *Monro*, in his excellent treatiſe upon the nerves, and the illuſtrious Baron *Haller*, in his great work, in which he gives a complete view of every thing that relates to the phyſiology of the human body, with moſt other anatomiſts, eſteem the uſes of the Ganglions abſolutely unknown.[*]

Before

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[*] I had made ſome progreſs in a hiſtory of the anatomy of the brain and nerves, to prove this point; and to ſhew how limited our knowledge is, and how few the real improvements are, which have added to the ſtock of knowledge concerning the nervous ſyſtem, derived from the moſt ancient anatomiſts: but finding it impoſſible to procure the books neceſſary to this deſign, I have given it up, at leaſt for the preſent.

That nothing probable on the uſes of the Ganglions of the nerves was before known, will appear by conſulting the Elem. Phyſ. of Baron *Haller*. For this purpoſe I add the following quotation from the anatomy of the nerves of Dr. *Monro*, ſen. my firſt maſter in anatomy.

" Some have thought the Ganglions of the nerves to be glandular, and to perform a ſecretion.—Others, from their firm texture, ſuppoſe them to be

muſcular

Before I proceed to examine into the uſes of Ganglia, it will be proper to premiſe, as firſt principles, the following propoſitions concerning the nervous ſyſtem, which are demonſtrated by anatomiſts and phyſiologiſts.

1. The brain conſiſts of a glandular ſubſtance of a cineritious colour, and abounding with blood veſſels, called its cortical ſubſtance: the medullary part of the brain ariſes from the cineritious, and the nerves from the medullary ſubſtance; of which they are prolongations.

2. Every

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muſcular, and to ſerve to accelerate the motions of the liquor in the nerves which proceed from them; but as no proof is offered for either of theſe opinions, they cannot be maintained.—Others would make them ſerve, 1. To divide a ſmall nerve into many nerves; and by theſe means to encreaſe the number of nervous branches. 2. To make nerves come *conveniently* by different directions to the parts to which they belong. 3. To reunite ſeveral ſmall nervous fibres into one large nerve. Since no *proof* is brought that theſe three things *cannot be done without* the interpoſition of a Ganglion, but, on the contrary, we ſee them performed, where there are no Ganglions, we muſt continue to acknowledge ignorance, concerning the uſes of theſe knots the Ganglions."

Theſe ſenſible obſervations ſeem equally ſubverſive of an hypotheſis, not very different, of *A. Monro*, the ſon, publiſhed 1783, in his work on the ſtructure and functions of the nervous ſyſtem, p. 57—117.

" Theſe complications of the nerves being invariably deſtined for particular parts, this general uniformity in connection and diſtribution muſt anſwer ſome purpoſe ſuperior to mere mechanical convenience." This was the opinion of the deceaſed *J. Hunter*; and ſo far as reſpects the Ganglions, is what I prove in this Eſſay. Whatever defects may be found in it, the reader will recollect, that at the time I began my Inquiries, phyſiology did not ſo much as hazard a plauſible conjecture on the ſubject.

2. Every nerve is, properly ſpeaking, a bundle of ſmaller nerves, or cylindrical threads; all of which run parallel to each other, without confuſion (except perhaps in Ganglions) from the brain to their terminations; every funicle of which a nerve conſiſts has its membraneous coat, continued from the *pia mater*.

3. The funicles, (2) which to the unaſſiſted eye ſeem ſingle, and to compoſe a nerve, with the help of a microſcope, are found made up of innumerable ſmaller filaments. From late microſcopic obſervations, the medullary matter appears to aſſume a ſpiral appearance, in the courſe of the nerves: and in the ſenſory organs and muſcles appears like mucus; but muſt be there curiouſly organized, in ſome manner yet undiſcovered.

4. Theſe nervous filaments or threads, derived from the medullary part of the brain, convey impreſſions or ſenſations to the ſoul, or ſentient principle ſeated there.

5. Undoubted Experiments demonſtrate that the power of voluntary motion is derived from the brain, by the nerves, to the muſcles of the part moved. By experiments we endeavour to imitate or illuſtrate this: thus, if the brain, or any nerve iſſuing from it, be ſtimulated by any irritating cauſe, the parts whoſe nerves are irritated, whether

in the brain, or lower down, will always be convulſed. And ligatures upon nerves, with no leſs certainty intercept the efficacy of this irritation above them, than they render the parts paralytic or immoveable by the will.

6. But this power or cauſe which is conveyed by nerves, and puts muſcles in action, is not inſtantly loſt in nerves, when their communication with the brain is interrupted by cutting the nerve aſunder, or tying a tight ligature upon it. For if the nerve be irritated below, or betwixt the ſection or the ligature, and the muſcle it goes to, the muſcle is convulſed as effectually as if the communication with the brain had not been cut off. Thus, after the head is cut off, irritations of the ſpinal marrow convulſe the trunk of the body and limbs entirely: in like manner irritations of particular nerves, the *phrenic* for example, after the deſtruction of the ſpinal marrow, throw the diaphragm into convulſive contractions: thus the muſcles of the head, eyes, and tongue are convulſed by probes thruſt into the brain, when the head is ſeparated from the body: and thus the heart itſelf is made to contract, after it is ſeparated from the body. So that it is evident, that, though in a general view and ultimately, the nerves and muſcles depend upon the brain for their fluid, or whatever is the cauſe of their energy; yet that dependance is by no means ſo immediate, but that effects may be

produced

produced by and in nerves and muſcles ſeparated from the brain, through that remaining ſtock of energy ſometime before derived from it, and not ſo ſuddenly diſſipated and exhauſted as ſome theories would incline us to believe.

Hence alſo we may conclude, that it is not certain that irritability, is ſo entirely a diſtinct property of muſcular fibres, as to be totally independent of the nerves; as no experiment can be contrived, in which muſcular fibres can be perfectly ſeparated from the nervous web, intermixed with, and diffuſed among them; and to which the contraction of muſcles irritated after ſeparation from the body, may be owing in a great meaſure.

SECT. II.

Seat and genuine uſe of Ganglions.

1. GANGLIONS are obſerved to be ſeated generally upon nervous cords, formed by the union of ſeveral different nerves; and ſometimes too before nervous cords ſend off branches.

All of them, except the ophthalmic Ganglion, (and two or three beſides, belonging to the fifth pair, not conſtantly found,) either are ſeated upon the great ſympathetic nerves, or are, as we ſhall experimentally ſhew hereafter, to be conſidered as their origins.

2. They appear to abound with blood veſſels: and it is obſerved by *M. De Haller*, that the nervous filaments loſe in Ganglions their rectilineal parallel direction, (No. 2. above,) and ſeem to be intimately commixed therein.*

3. The

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* This was already obſerved by *Gliſſon*, who calls the ordinary unions of the nerves *aſſociations*; and thoſe now called Ganglions, he calls *plexus.* "Inter aſſociationes haſce & plexus id diſcriminis eſt, quod illæ *fibras ſuas peculiares magis diſtinctas, minuſq; invicem implicatas* ſervent; quod etiam *nodis* ut plurimum careant," *Gliſſon*, de Anatome Hepatis.

This

3. The bulk of a Ganglion conſtantly exceeds that of all the veſſels and nerves which it receives, and of which it may ſeem compoſed.* Hence we may reaſonably conclude, that in Ganglions the different nervous filaments are very intimately mixed; that a new nervous organization, or arrangement of the medullary ſubſtance, probably takes place in them, and is ſubſervient to ſome important purpoſe in the animal machine; a conjecture which has the ſanction of a *Winſlow*, and the lateſt, as well as the earlier thoughts, of the great *Morgagni* in its favour,† though that purpoſe is not pointed out by them.

In

This is confirmed by the authority of Baron *Haller*, In Ganglio involucrum ex dura celluloſa tela eſt, ſive Vagina Rubens firma, ipſique etiam funiculi nervei interrumpuntur, ut fibrarum porro rectarum parrallelum ductum, non diſtinguas, videanturque ii funiculi intime commiſceri. *Haller* Elem. Ph. T. iv. p. 203,—Prim. Lin. No. 377.

* Gangliorum moles major eſt quam ſit aggregatum omnium vaſorum ingredientium atque egredientium; quo ſit, ut ad eorum productionem, neceſſe ſit concurrere, præter communia vaſa, *peculiare aliud corpus*, non tam ex cohærentia & complicatione præfatorum nervorum, ac ſanguiferorum, *quam ex novis organicis partibus* quas provida ſolerſque natura, ſubſiſtentibus probeque excoctis liquidis, ſimul etiam elongatis varieque diſpoſitis ſolidorum fibris, fingat & creat. *Lanciſ*. de Gangl.

Certum eſt, ganglia conſtanter majora eſſe, & nonnunquam inſigniſſime majora quam nervus eſt ex quo quodque oritur. Certum eſt etiam, nervos ex gangliis ſere ſemper numeroſiores prodire quam ſubierunt. *Haller*, ib.

† See *Morgagni* adverſar. Anatom. T. ii. p. 71. & ejuſdem de Sedibus & Cauſis Morb. Epiſt. 10. Art. 14. Ces Ganglions ſont compoſes d'un melange de Subſtance Moelleuſe, & de ſubſtance cendree, arroſe de pluſieurs petits vaiſſeaux

In order to determine the particular uſe of Ganglions, (the intimate ſtructure of which, equally with that of the brain, and medullary ſubſtance of the nerves, we are hitherto ignorant of,) in the animal ſyſtem, let us try if ſomething tending this way may not be ſuggeſted, by reflecting on the functions and motions of the parts ſupplied principally by nervous cords from below the Ganglions.

The intercoſtal, more fitly called the great ſympathetic nerves, abound moſt with Ganglions;* and by examining what is particular and peculiar in the

motions

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vaiſſeaux Sanguins. Traite' de la Teſte. 629. *Winſlow.*—See alſo his Expoſition Anatomique, p. 462. 4to.—and following quotation. See alſo *H. A. Wriſberg*, De Ganglio a Plexu ſemi lunari in abdomine Comment. Gotting. vol. 2. 1780. Cum in pleriſque nervis, ramorum diviſio, perſciſſa inter media celluloſa, ad ortum nervi continuari queat, illa tamen nervorum loca, ubi frequenter Ganglia filamentis intermixta ſunt, a regula exceptionem faciunt. Ibid.

* Ces nerfs communement appelle's Intercoſtaux "Dans toute leur etendue, ils repreſentent deux cordons, deviſe's & comme entrecoupe's d'eſpace en eſpace par un grand nombre de petites tumeurs ganglioformes, moyennant leſquelles ils communiquent en arriere par deux fillets collateraux fort courts, & produiſſent en devant toutes leurs ramifications particulieres.

"Ces tumeurs ganglioformes, ou Ganglions, different plus ou moins en volume, en couleur & en conſiſtence; & on les peut regarder comme autant *d'origines ou des Germes* diſperſes de cette grande paire des nerfs *ſympathiques*, & par conſequent comme autant *des petits Cerveaux.*" *Winſlow* Expos. Anatom. p. 462. 4to. edit.

Super omnes nervos, intercoſtali, Ganglia ſunt frequentiſſima, in cer-

vice

motions of parts to which theſe nerves are diſtributed, we ſhall probably be led to the uſes of Ganglions.

The muſcular ſubſtance of the heart has its principal, or rather all its nerves, from the intercoſtals, which are always detached from the principal cords below the Ganglions, and chiefly from the inferior cervical Ganglion. The few nervous cords from the *par vagum*, or eighth pair, which in the human ſubject are ſent towards the heart, are almoſt totally ſpread upon the pericardiam and great veſſels.*

In the abdomen, this nerve unites with the *par vagum* of the right ſide,† and they together form the

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vice quidem tria; in thorace, lumbis, & pelvi tot, quot nervorum ex ſpinali medulla propagines intercoſtalis accepit: tum in cordis vicinia, ſub diaphragmate, circa Arteriæ cælicæ & meſentericæ originem. & circa renem paſſim in plexuoſis retibus. *Haller* El. Phyſ. T. iv. p. 202.

* Ibid T. i. p. 356. See alſo *Lanciſi* de motu cordis & Tab. iv. v. viii. Neubaver nervorum cardiacorum, Deſcr. Lips. 1772. *J. C. Walter* nervor, Thoracis & Abdominis Tabulæ, Berol. 1783, ſol. magn.

† *Winſlow* Traite des nerfs, No. 141.—The reader is alſo deſired carefully to examine the 23 Table of *Vieuſſens'* neurographia, which repreſents the courſe of the great ſympathetic nerves, with their ganglions and connexions; and the accurate deſcription of *Wriſberg* of this nerve, the reſult of diſſection of ſixty bodies. "Medulla ſpinalis, quantum quidem ego Scio, nulli abdominalium viſcerum, ſurculum mittit, ſed omnia illa nervorum filamenta, mediante nervo ſympathetico maximo viſceribus impertiuntur." Comment. Gotting. vol. 2. 1780.

the great ſemilunar Ganglion; from which, and from other Ganglions formed in inferior parts of the abdomen, filaments are diſtributed to the inteſtines, the liver, the ſpleen, the kidneys; and ſome of them deſcend to the fallopian tubes, uterus, and other parts in the pelvis; ſome of which are alſo in part furniſhed with filaments from the lumbar nerves.*

The

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* The ancients traced only a very few nervous filaments diſtributed to the heart. *Fallopius* firſt traced the great number of nerves ariſing from Ganglions, which form plexus peculiar to the heart. His deſcription of the great ſolar Ganglion, of the nerves which compoſe it, and of thoſe ſent from it to the abdominal viſcera, as well as his deſcription of the cardiac nerves, is ſo juſt and accurate, that though more modern anatomiſts have varied from it, they have ſeldom mended it. The deſcriptions of later anatomiſts differ indeed widely, reſpecting the origin, number, and diſtribution of the nerves ſent to the heart.

That of *Willis*, erroneous in many reſpects, deſcribes the cardiac plexus as derived from the intercoſtal nerves, and the eighth pair. He obſerves that the eighth pair ſends more nerves to the heart in brutes, than in the human ſubject; a fact allowed to be true by B. *Haller*, and deſerving the attention of phyſiologiſts and philoſophers.

The deſcriptions and figures of *Vieuſſens*, taken with indefatigable induſtry from the diſſection of five hundred bodies, are more conformable to truth and nature than thoſe of any preceding writer; and till thoſe of *Neubaver* and *Walther* appeared, have been exceeded by none. From them a few branches of the eighth pair, appear to be diſtributed to the pericardium and great veſſels: but the *proper cardiac nerves*, which ſupply the muſcular ſubſtance of the heart, ariſe below the Ganglions of the intercoſtals.

The leſs correct deſcriptions and figures of *Lanciſi*, on the whole, agree with the above; but in particular inſtances of detail, immaterial to our ſubject, he differs both from *Vieuſſens* and *Winſlow*; in whoſe new deſcription

The heart and inteſtines, being wholly ſupplied by nervous filaments detached below ſome remarkable Ganglion, we muſt inquire what is peculiar in the motions of theſe parts, or in their ſtructure: but the motions of the heart and inteſtines are remarkable, and exactly ſimilar, in being both involuntary, or not liable to be either ſtopped, renewed, or in any way controlled by the will.

Though

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tion we have new varieties, but ſtill an agreement with preceding anatomiſts, "That all the nervous cords ſent from the intercoſtal nerves to the heart, unite in one plexus, and that the nervous branches from the eighth pair are united and interwoven in it." In this agrees the deſcription of *M. Walther* the elder, which *Haller* allows to be exact, though in various other points his deſcriptions differ from thoſe of former anatomiſts, and are reckoned obſcure by *M. Senac*. The deſcriptions of *Haller*, in his notes to Boerhaave's Inſtitutions, ſeem an attempt to reconcile the contradictions of his predeceſſors. That publiſhed in Comm. Gotting. 1770, is profeſſedly taken from the examination of the cardiac nerves of the human ſubject. He publiſhed only what he ſaw, nevertheleſs he is certain, many nerves eſcaped his obſervation, *from the great difficulty of tracing them in any one ſubject*. The late deſcription of *Wriſberg* in Comm. Gotting. and the excellent figures of *Neubauer* and of *Walther* the ſon, though not in exact agreement with former anatomiſts, eſtabliſh and confirm the fact, "That the heart has all its nerves from below the ganglia, and alſo that all the abdominal viſcera are ſolely ſupplied with nerves from the great ſympathetic nerves, united in ganglia with the eighth pair, after a large portion of it has been diſtributed to the ſtomach." In this eſſential point anatomiſts, who have written ſince the firſt publication of this Eſſay, agree with thoſe who wrote before, however greatly they vary in other particulars.

The nerves of the heart are very numerous; no muſcle, ſays *Senac*, receives ſo many; late diſſectors agree with him on this point: they are formed into Ganglions and plexus's, are interlaced, united, and ſeparated, before they are loſt in the ventricles and muſcular ſubſtance of the heart. Theſe nerves convey the vital principle to the heart and inteſtines, Though it be very certain that theſe motions are excited in the heart, by the gentle ſtimulus of the blood upon the internal ſurface of that organ, and in the inteſtines by that of the ſecreted liquors, and of the food taken in; of which ſtimuli, theſe parts have

tines, ſo permanently, that when it ſeems loſt in other parts, when the reſt of the body ſeems dead, it ſurvives for ſome time in them, and appears even when they are ſeparated from the body, whether living or dead. From this living principle, communicated by the nerves, and excited by local ſtimuli, independent of volition, the action and motions of the inteſtines are carried on in the animal ſyſtem. The ſame living principle renders the heart ſuſceptible of motion by the ſtimulus of the blood, conveyed from the vena cava to the auricles, and, by them, thrown into the ventricles of the heart, and from thence into the arteries, to every part of the body, from whence it returns by the veins in a ſucceſſion unknown, till it was demoſtrated by the celebrated *W. Harvey.*

Let it once for all be obſerved, that the diſſection of the viſceral nerves is a moſt delicate and nice buſineſs: they can hardly be ever truly demonſtrated in a few bodies, or in courſes uſually given by profeſſors of anatomy. What *Vieuſſens* deſcribed after an examination of five hundred bodies, and *Wriſberg* by diſſecting ſixty, is not to be exhibited in a curſory demonſtration on one ſubject. If it be true, as undoubtedly it is, that anatomical inventors are very few, thoſe who truly deſcribe the viſceral nerves are ſtill fewer; and the various inconſiſtencies in very good authorities, are to be accounted for from the different degrees of accuracy, or the different methods of diſſection adopted by them; let prelectors in anatomy conſider what they deſtroy, in any ſingle ſubject, and what *Haller* ſays in the following paragraph, and they will cenſure leſs and inſtruct more.

" Quæ dixi (Elem. Phyſiol. de cordis nervis) ea vera eſſe, et vere a
" me viſa eſſe, non diffiteor, plena eſſe nunquam ipſe ſperavi aut pro-
" miſi: ſatis memini, pone cor, loco impeditiſſimo, nervos eſſe numero-
" ſos, qui oblique introrſum deſcendunt, ab intercoſtalibus ut videtur
" nati, quos ex ratione loci putes cor adire? Eos nunquam niſi mutilatos
" vidi."——Diſſertatio ad Figuram nervorum Anderſch. Comm. Gotting.
2 Tom. 1771.

have the quickeſt and moſt exquiſite perception; yet this being ordinarily not ſo ſtrong as to make us conſcious of its action, much leſs painfully ſo, can hardly be ſuppoſed to render theſe motions quite uncontrollable by the will, without ſome other efficient cauſe.*

Anatomy diſcovers no peculiarity in the muſcular ſtructure of theſe parts likely to account for this; and excepting in their nerves having Ganglions, which ſeem indeed appropriated to them, no anatomical difference has been obſerved, no mechaniſm which theſe parts have, more than, or different from thoſe muſcles which are ſubject to the will.

May we not then reaſonably conclude, that Ganglions are the inſtruments by which the motions of the heart and inteſtines are from the *earlieſt* to the *lateſt periods* of animal life, *rendered uniformly involuntary*; and that this *is their uſe?*

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* In an excellent explanation of the *vital and involuntary motions of animals*, by a learned profeſſor and ingenious writer, in whoſe death the medical world has ſuſtained an irreparable loſs, it is remarked with the acuteneſs proper to this excellent author: "I imagine, that the mind's *want of power* over the motion of the heart, is not only owing to its being continually acted upon by a ſtimulus, *but in part to an original conſtitution*; and that though we ſhould ſuppoſe this organ for a little while free from every degree of irritation, yet the mind by an effort of the will could not remove it." *Whytt*'s Eſſay on the vital and involuntary motions of Animals, p. 316. I hope in this Eſſay to point out the *Conſtitution* here ingenuouſly hinted at.

which they ſubſerve by a ſtructure indeed unknown to us, (yet evidently different from that which uſually obtains in nerves,) no leſs than that of the brain, though it ſeems not improbable the firſt may have ſome analogy to the laſt.

This concluſion concerning the uſe of Ganglions is ſupported by every truly parallel inſtance. Thus the motions of the *uvea*, or *muſcular circle of the pupil* of the eye, ever contracted or dilated, as the eye is more or leſs irradiated with light,* are as much *involuntary* as thoſe of the heart itſelf; though ſome unneceſſary diſtinctions have been made concerning them, of which we ſhall afterwards take notice; and it is known to anatomiſts, that the muſcular fibres of the uvea are ſupplied by nerves from the *lenticular Ganglion*, which ſeems formed ſolely for the uſe of that muſcle, and for that purpoſe.†

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* Dilatation is the *reſt*, or natural ſtate of the pupil, as contraction is its *action*. It dilates in an obſcure light and when the eye is directed to diſtant objects, and contracts when directed to near objects, and when a brighter light ſtrikes upon the retina.

† See *Winſlow*'s deſcription of this Ganglion, Traite' des nerfs, No. 22, 23, 24. It is known by the ſynonymous names of Ganglion lenticulare, Ciliare, and Ophthalmicum: the following is Baron *Haller*'s accurate deſcription of it: " Tertii Paris ramus, vel reliquus truncus, eſt radix præcipua craſſa breviſque ganglii, eademque extrorſum incedit, inque nervo optico, ſub muſculo abductore, efficit *Ganglion ciliare* ſive ophthalmicum ovale, *perpetuum*, perminutum. Eſt ubi id a ſolo tertio naſcitur, *neque deeſſe unquam vidi*, neque duo, aut plura fuiſſe, ut nuperi aliqui habent:—Nervi quinti Paris ramus primus ophthalmicus dictus, " edit

When we conſider that the nerves, which are more immediately miniſterial to the ſoul,* and convey impreſſions of external objects to it, have no Ganglions; that they are never found upon the olfactory, optic, or auditory nerves; and that they are as rare upon the nerves inſtrumental in voluntary motion, as they are conſtant and numerous in parts whoſe motions are independent of our volitions, we have in this caſe the firmeſt grounds of belief that ganglia, on the latter, are placed as checks to the powers of volition; and that the former are exempted from them, becauſe they would have interrupted and prevented the determinations of the will from reaching the parts intended to be ſubject to it, and upon ſenſory nerves, would have rendered the notices we receive much leſs diſtinct, perfect, and acute than they ought to have been.

The left nerve of the eighth pair, diſtributed to the ſtomach, and probably the cauſe of the diſtinct and exquiſite ſenſation of that organ, and of its remarkable

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" edit ramum, euntem in Ganglion ciliare, *Ex eo ganglio ſurculi tendunt in* " *uveam*, fibrarumque radiatarum partem aliquam ſed exiguam faciunt." *Haller* Elem. Phyſ. p. 427—429.

[*] Nervos qui ſenſibus ancillantur, ut olfactorios, opticos, auditorios, alioſque nullis Gangliis munitos eſſe. Sunt enim ſenſus in corpore quasi quædam viæ ut Tullius ait, ad oculos ad aures ad nares a ſede animi perforatæ; nulla idcirco in iis aut repagula, aut incitamenta addenda, vel interponenda erant. *J. Mar. Lancis* in Diſſert. citat.

remarkable ſympathy with the head, ſeems alſo principally concerned in tranſmitting the ſenſe of hunger to the mind, and therefore may be conſidered as a ſenſory nerve. This notion ſeems proved by, and in its turn throws light upon, thoſe experiments made by the moſt celebrated anatomiſts, in which the eighth pair of nerves was cut aſunder or tied in brutes, and by which the functions of the ſtomach were moſt manifeſtly diſordered.* The lateſt and beſt anatomiſts agree there is no Ganglion found on this nerve, between its origin and the ſtomach, where it is chiefly ſpent.†

If Ganglions were not intended to check, and did not actually limit the powers of volition, the diaphragm had probably been entirely furniſhed from the intercoſtals, as moſt of the parts in the thorax above it, and in the abdomen below it,

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* "Nervo Octavi Paris diſſecto, Vox ſublata eſt, & reſpiratio factà gra- "vior, & *concoctio ciborum deſtructa*, & *cibus in Ventriculum non venit.*" *Morgagni* in Comm. Bonon. & de Cauſis & Sedib. Morb.

"Nervo Octavi Paris ligato, reſpiratio difficilis, vox ſublata eſt, *ciborum* "*horror*, vomitus, ventriculus fœcibus pleniſſimus, demum cibi omnino "in ventriculo ita corrupti, ut ſolent craſſis in inteſtinis eſſe." *Brunneri* nepot. Exp. in *Haller* Elem. Phyſ, Tom. iv. p. 324.

† "Nervi anaſtomoſes inter ſe ut vaſa, frequentes faciunt, & in concurſu "ramorum ex diverſis truncis ortorum imprimis Ganglia reperiuntur. In "ſenſoriis unice nervis non reperiuntur, & *nulla ſunt Octavo*, phrenico, ner- "vis artuum." A. van *Haller* Prim. Lin. Phyſ. No. 377.

are. But as the motions of this muſcular membrane were to be controulable by the will, we find peculiar nerves, namely, the phrenic, which are deſtitute of Ganglions, ſent to it from a great diſtance.

SECT. III.

Anatomical objections ſtated and anſwered: our doctrine ſupported by experiments, and by medical and anatomical facts.

THUS far have I ſtated the facts and arguments which tend directly to prove the doctrine I have advanced concerning the uſes of Ganglions. And though I am ſenſible they may not have ſuch force, and far leſs ſuch advantage of arrangement, and of authority, as to compel conviction; and are rather likely to ſatisfy thoſe who, laying aſide prejudices of various kinds, are candidly diſpoſed to give truth that peaceful reception which it ſo ſeldom has met with, than to ſtand the rigorous teſt of a captious controverſy: I am, notwithſtanding, perſuaded that my main concluſion will be found to have a conſiderable weight of probability, yea, evidence in its favour, when weighed againſt thoſe objections which may be brought againſt it, and thoſe difficulties from which I am conſcious it is not exempt. Theſe however are chiefly ſuch as ariſe from our imperfect knowledge of the nervous ſyſtem; a terra incognita, which remains to immortalize the name of ſome future diſcoverer in anatomy.

It is well known, for inſtance, and it is almoſt the only objection of any weight, to which our doctrine is liable, " That all the nerves ſent from " the ſpinal marrow, have Ganglions where they " ſend off the filaments which communicate with " the intercoſtals,"* The concurrence of facts in favour of our doctrine, rendered it highly probable that theſe Ganglions reſpected excluſively the great ſympathetic nerves, and that they were the firſt checks to the uſual powers of volition, and affected only the filaments ſent to the ſympathetic nerves, leaving the other nervous filaments of the ſpinal nerves, fit and free for the conveyance of the commands of the will, as, in fact, they are chiefly diſtributed to muſcles under its power and direction; but it did not till lately occur to me that this might be determined and proved one way or other by experiments.

It is allowed by phyſiologiſts, that when any nerve is irritated, the muſcle it goes to, or if it is a large nerve, or bundle of nerves, all the muſcles ſupplied from them, are by that irritation violently convulſed. [See Prop. 5—6. § I.]

If then, it ſhall appear, that irritations and injuries of the ſpinal marrow, (from which the intercoſtal, or great ſympathetic nerves which ſupply the heart and inteſtines truly ariſe, as well as thoſe nerves diſtributed to the limbs,) occaſion violent convulſions of the limbs, and yet do not in the leaſt affect the heart and inteſtines, parts the moſt irritable of any in the body; as will indeed be manifeſt by the following experiments: the difference will probably be accounted for from the intervention of Ganglion after Ganglion, conſtantly found betwixt the ſpinal marrow, and the heart and inteſtines: the ſubtlety of experiments in determining what no microſcope or anatomical knife would detect and aſcertain, will be acknowledged, and the unprejudiced inquirer into nature, will be led to aſcribe thoſe uſes to Ganglions which I have done.[*]

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* *Vieuſſens* Neurogr. Tab. 23.

I. On the 4th of *March*, 1767, a kitten a week old had its head cut off betwixt the firſt and ſecond vertebræ of the neck: the thorax was opened with all expedition, and the heart laid bare to view, and obſerved for ſome time, that any difference might be more certainly noticed. After the animal ceaſed to move its limbs, I touched the ſpinal marrow with a probe; immediately the extremities of the animal were all ſtrongly convulſed; but the heart alone, ſeemed unaffected, and continued to move

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[*] See Primæ Lineæ Phyſiolog. Sect. 376.—Edit. Gotting. 1751; and *Monro* on the Structure and Functions of the Nervous Syſtem. p. 30.

without acceleration, or any degree of alteration whatſoever.*

Betwixt this time and *April* 10, I repeated the ſame experiment upon half a dozen kittens, ſtill younger than the firſt; upon opening the thorax the heart beat at leaſt ſeventy ſtrokes in a minute.

When the heart beat only forty in a minute, or thereabout, I began gently to touch the ſpinal marrow with the point of a probe, and the limbs were immediately convulſed, but the heart not in the leaſt affected.

I ſlit open both the ventricles of the heart, ſo as to let out all the blood they contained, and inſtantly the heart ceaſed to beat; (though before the blood is thus removed its pulſation continues very long in animals ſo young, eſpecially of this kind;) but the auricles which were not opened, and therefore were ſtill ſtimulated by the blood, beat on.

After this preparation in ſeveral of theſe animals, I thruſt

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* "Convulſiones totius Animalis, ab irritata medulla ſpinali natæ, "cordis motum non ſuſcitant." *Haller* Elem. Phyſ. T. ii. p. 205.

Theſe experiments were tried, and their events, as here related, obſerved, long after the firſt draught of this Eſſay had been ſent to the Royal Society. I therefore appeal to ſuch perſons as may chuſe to repeat them, diſagreeable as they are, whether I miſrepreſent them through prejudice, or not.

I thruſt the probe into the ſpinal marrow, but the heart nevertheleſs continued in perfect reſt and inaction: though when its ſubſtance was pricked with the point of a knife, it might ſtill be made to contract.

But though the heart and inteſtines remained equally unaffected in all the trials I made, by thruſting the probe into the ſpinal marrow, the following convulſions occaſioned by it deſerve particular enumeration.

All the limbs were violently convulſed.

The muſcles of the back were convulſed, and the ſpine bent as in the opiſthotonos.

The intercoſtal muſcles were all contracted, and their natural action, that of drawing all the ribs nearer each other and upwards, was rendered a matter of occular demonſtration.

The diaphragm was contracted ſtrongly, notwithſtanding the phrenic nerve of one ſide was divided, in making ſimilar experiments, by pricking and ſtretching it; which, by the way, conſtantly occaſioned a convulſive contraction of the diaphragm.

Even by plunging the probe into the brain, after

ter the head had been cut off ſome minutes, the eyes, tongue, and lower jaw were made to move.*

I have made the ſame experiments, with like conſequences, upon frogs.

But theſe experiments muſt be made within leſs than a quarter of an hour after decapitation; half an hour after, no ſuch effects follow the deſtruction of the ſpinal marrow: and they ſucceed beſt by previouſly opening the ventricles of the heart. By the way, the irritability of the muſcles continues not longer than the power of exciting contractions in them by irritating the correſponding nerves.

Experiments, ſimilar to theſe in event, have been made on frogs, by *Stuart*, Baron *Haller*, Dr. *Whytt*, and many more.

" When I opened (ſays the laſt of this inge-
" nious triumvirate) the thorax of a frog, imme-
" diately after decollation, and deſtroying its ſpinal
" marrow, I obſerved its heart beating after the
" rate of ſixty in a minute, which is four or five
" pulſations

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* In an account of the execution of *Mary* Queen of *Scots*, it is declared that her lips ſtirred up and down almoſt a quarter of an hour after her head was cut off. *Ballard's* Memoirs of the learned ladies of Great Britain, p. 166.

" pulſations leſs than I have generally ſeen the " hearts of frogs make in that time, when the " thorax was opened without decollation.*

II. " Some young gentlemen having hanged a " cat, till ſhe was quite dead, opened the thorax, " and obſerved only a tremulous motion in the " heart, which ſoon ceaſed, but was renewed by " pricking it with a ſharp inſtrument: after this, " by ſqueezing the cardiac nerves downwards, or " otherwiſe irritating them, the heart was made to " perform two or three pulſations, which it con- " tinued to do for a conſiderable time, whenever " the cardiac nerves were thus ſtimulated."† Theſe experiments were made with no kind of view to the doctrine which I ſhall endeavour to ſhew they enforce and ſupport.

III. Animals are killed, ſome ſooner, and others, eſpecially of the cold kind, (as frogs and tortoiſes, on account of the largeneſs of the ſpinal marrow,) much later, by cutting through the ſpinal marrow near its origin. The cutting through the intercoſtal nerves, or the tying ligatures upon them, is alſo ſooner or later *fatal* to the animals the experiments have been tried upon, by finally deſtroying the *heart's motion*, and inſtantly, in a wonderful manner, *weakening and diſturbing its motions.**

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* See *Whytt's* Exp. on living and dying animals, Eſſ. Ph. and Lit. 2 vol. p. 282. and *Whytt's* Phyſical Eſſays.

† Eſſay on the vital and involuntary motions of animals, by *Whytt*, p. 355.

Theſe experiments prove that the Ganglions on the ſpinal nerves do not hinder the irritation of the ſpinal marrow from cauſing convulſions in the voluntary muſcles: and that the Ganglions (1) do, in all probability, hinder that cauſe from acting (as without their intervention it muſt have done)

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* Octavæ conjugationis nervis, una cum nervis par intercoſtale conſtituentibus, circa cervicem ex tranſverſo reciſis, animal illico languore futuræ mortis prænuncio afficitur, *tremulos motus patitur*, vires illius ſenſim labaſcunt, & intra 24 circiter horas, vita deſtituitur, quæ per illud breve temporis ſpatium, ſpiritu animali ſuſtinetur, quem medulla ſpinalis, & nervei plexus intra medium & infimum ventrem latitantes naturalibus & vitalibus partibus ſuppeditant. *Vieuſſens* neurographia, cap. iv. Lower de Corde. *Haller*, Elem. P. T. i. p. 464—5. And *Morgagni* de Sedibus Morb. Exp. xix. art. 23. deſcribes the encheireſis, or manner of making this experiment, and obſerves, it is impoſſible in brutes to cut or tye the intercoſtal nerves or par vagum, ſeparately, without dividing or tying both together; a fact, which has not been always conſidered in reaſoning upon this experiment.

The experiments made by cutting and tying the ſplanchnic nerves are favourable to our doctrine.

In the experiments of the ingenious Dr. *Whytt*, 2 vol. Eſſays phyſical and literary, it appears that the deſtruction of the ſpinal marrow and decollation do not ſo immediately weaken and put a ſtop to the heart's motion in frogs, as opium injected into the ſtomach and guts, or applied to the muſcles and bowels of the lower belly and thorax. The ſame obſervation holds as to the effects of laurel water. Hence alſo it appears, that the motions of the heart and inteſtines depend more directly upon the influence derived from the Ganglions, than that of the brain itſelf. The experiments of dividing and tying the ſplanchnic nerves, favourable to our done) upon the heart, by means of its nerves, chiefly ariſing from the ſpinal marrow originally: and therefore it ſeems evident, and beyond a plauſible conjecture, that the Ganglions on the ſpinal nerves relate excluſively and ſolely to the intercoſtal, or great ſympathetic nerves, for the purpoſes I have endeavoured to prove: this doctrine derives farther confirmation from experiment (2,) as we thereby ſee that the heart may be made to move, as all other muſcles may, by irritating or ſqueezing its proper

our opinion, have been performed by many anatomiſts. I mention principally ligatures made on the eighth pair of nerves, confounded for the moſt part in the deſcriptions of anatomical writers, till *Vieuſſens* properly diſtinguiſhed them. The eighth pair was tied by *Riolan*, and both cut and tied by *Plempius*, *Lower*, *Willis*, and *Boyle*. The ſame experiments have been repeated by *Chirac*, *Courten*, *Berger*, *Baglivi*, *Morgagni*, *Heuerman*, *Bohn*, *Varignon*, *Senac*, *Brunner*, and B. *Haller*. The animals all ſurvived for ſeveral days. The motions of the heart were weakened in ſome, though not very viſibly in others. The moſt conſtant effects, were a ſinking of voice, or aphonia, difficult reſpiration, and palpitations of the heart; vomiting, and endeavours to vomit, as in the experiments of *Haller* and *Brunner*, in dogs and rabbits, and an appearance of putreſcence in the contents of the ſtomach. A proof that the ſtomach derives its action and vigour, in a very great degree, from this nerve. *Haller* adds, "Neque vidi irritato octavi paris nervo, cordis motum acceleratum fuiſſe, pulſum vehementiorem ſucceſſiſſe, aut ſanguinem validius erupiſſe. Neque ab octavo pare irritato cordis motum ſuſcitari vidit *Senac*." *Hall.* El. Ph. T. i. p. 463.—in 4to. When we recollect that theſe ligatures, ſections, and irritations, are made high in the neck, and above the ganglia of the nerves, we are enabled to account for the events here deſcribed, and ſee in them evidences of the uſes here aſſigned to the Ganglions of the nerves.

The ſection of the great ſympathetic nerves, kills animals much ſooner, than that of the eighth nerve only. Yet *Vieuſſens*, *Heuermann*, and *Senac*, found proper nerves, below their Ganglions: and, that the motions of the heart cannot long continue, in warm animals eſpecicially, after the diviſion of their principal nerves, (3) which ſhews the dependance of the heart *(Prelim. Prop.* 6) ultimately, as that of all other muſcles, upon its proper nerves, and their connection with the brain.

Theſe concluſions have received additional proof from new experiments and diſcoveries in animal electricity,

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found them ſurvive that experiment from ten to thirty hours. Even after the ſympathetic nerves and eighth pair are both cut through, animals live ſome time. Even the cutting through the ſpinal marrow near the head, which intercepts all communication with the brain, and is inſtantly fatal, does not immediately arreſt the motion of the heart.

Several inſtances have occurred in my practice in which the ſpinal marrow has been injured by falls, or branches of trees, or other ponderous bodies violently falling on the ſpine. By theſe accidents the ſpinal marrow has been wounded, and in ſome inſtances half cut through, ſometimes juſt under the points of the ſcapulæ, in others higher or lower in the ſpine. In all of them entire immobility of limbs, and inſenſibility in the hips, thighs, and lower extremities, has followed. The bladder is ſeldom emptied without the catheter, and yet the ſtools came away involuntarily. The pulſe gradually ſinks, the belly becomes tympanitic, and the patient dies in a week or fortnight, according as the injury has been greater or leſs, or higher or lower in the ſpine. Similar diſeaſes affecting the ſpinal marrow, ariſe eſpecially in ſcrophulous perſons, without external injury. A tottering debility, ending in palſy of the lower extremities, announce the diſeaſe; a ſtarted vertebra, or gibbous ſpine, points out its cauſe: it is often cured by iſſues made by means of cauſtics, and ſometimes by the uſe of the Bath waters. The cyder, or ſaturnian cholic, often ends in ſimilar complaints, without any viſible alteration in the ſpine. Such perſons have more than once fallen under my care, and been cured by warming and ſtimulating balſamic and electricity, by *Galvani*, *Volta*, Dr. *Valti*, and others.

But the objection is entirely obviated by a diſcovery made by Dr. *A. Monro*, the preſent celebrated profeſſor of anatomy at Edinburgh. "When (ſays he) we carefully trace the anterior and poſterior bundles which form the ſpinal nerves, we find each has its proper hole in the ſpinal ſheath of the dura mater, and it will be found that the poſterior

and aperient medicines; the Bath waters have alſo good effects in ſuch caſes.

Laſtly, when the heart is cut out of the body, and cut in pieces, they continue to move and palpitate: the experiments have been often repeated on ſerpents, turtles, frogs, and many young animals.

It is in vain that *Haller*, and others, aſcribe this animation, or vital principle, to a vis inſita in muſcular fibres only, excluſive of a power derived from nerves, which are ſo intimately and inſeparably mixed with all muſcular fibres, that ſtimuli muſt ſimultaneouſly act upon the nerves and muſcular fibres they are applied to: the nerves actuate theſe muſcular palpitations, for a time, out of the body, as well as muſcular actions within it. The nerves animate the heart and other viſcera for a conſiderable time, and to a conſiderable degree, after they are divided, and all communication interrupted with the brain and ſpinal marrow. Such facts abſolutely decide againſt the old hypotheſis of *animal ſpirits* and their inconceivable velocity, and leave us in doubt whether their ſtructure be tubular or not: theſe facts, in fine, leave us ſtill *ignorant how the nerves act:* and no dawn, no ray of light, pierces into thoſe ſublime ſecrets of nature, which are alone unveiled to that ſelf-exiſtent Being, who animates every living creature.

The organization of the nerves, ſimilar in all appearance, to that of the brain, and poſſeſſing for a limited period ſomething of its energy, even terior *bundle only ends in the Ganglion*, and that the anterior bundle, which does not paſs through the Ganglion, does not incorporate and unite with the poſterior till it has paſſed through the Ganglion." See on Structure and Functions of the Nerves, p. 30.

The intercoſtal nerve receives the nervous branch detached from the poſterior bundle of each ſpinal nerve, only after it has paſſed through its proper Ganglion :

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even when ſeparated from it, is confeſſedly *unknown*. Nevertheleſs, it muſt be conceived as much more artificial than that of other parts, as the functions of the brain and nerves ſurpaſs thoſe of organs deſtined for groſſer purpoſes. If we can hardly conſider without wonder, the powers of organs which digeſt and aſſimilate food, into the proper ſubſtance of our bodies, what muſt we think of an organization which makes impulſe ſubſervient to ſenſation, and is the inſtrument of every mental power. In like manner we are ignorant of that organization in the nervous Ganglions, and by what means they check volition, and blunt ordinary perception, as they evidently do, and yet do not prevent the nerves derived from them, from ſupporting and animating the great organs of life; all of which are moved by local ſtimuli, irritating the nerves ſpread in theſe parts in a manner wonderfully uniform, yet beſt adapted to produce effects, which are as various, as they are neceſſary to the preſervation of human life.

Since the firſt publications of this treatiſe, (1764—1771) I find the celebrated *Fontana* and others have obſerved that long pins thruſt into the vertebral canal, occaſion convulſive movements in the limbs of frogs and other cold animals, without accelerating or altering the motions of the heart. He concludes, " The nerves then which are carried to the heart, are no way the organs of motion in this muſcle." Vol. ii. p. 194. The ſame paradox has been repeated in a late publication at Mentz, by *M. Behrends*. Had Mr. *Fontana* conſidered the ſtation of the ganglia on the nerves ſent to the heart and abdomen, his difficulty would have been ſolved :

Ganglion: but the anterior bundle is wholly appropriated and diſtributed to the voluntary muſcles, as has been diſtinctly noticed by *Haller*, Sect. 376. Prim. Lin. edit. Gott. 1751. His words are, "omnes nempe nervi ſpinales, vix uno alterove in collo excepto, egreſſi de vertebris, poſteriorem et anteriorem truncum habent. *Ille muſculis unice datus eſt. Iſte* producit radicem nerveam, quæ juncta ſodalibus, et addito exiguo ſurculo, qui a ſexto nervo cerebri, advenit, unum principem corporis humani nervum efficit, qui cum fere omnibus aliis nervis totius corporis conjunctus, ad cor, et abdominis viſcera omnia ramos nerveos educit." This fact completes

ſolved: he would have found his experiments beautiful proofs, that the interpoſed ganglia prevented his experiments from altering the motions of the heart, and alſo prevent the action of volitions there, and withall, the general confuſion of voluntary and involuntary action, from diſturbing the functions of the heart, inteſtinal tube, and internal glands.—Proceeding with the ſame precipitation of concluſion, he denies that the paſſions act on the heart, by the nerves.—In oppoſition to *Fontana*, I aſſert that the heart is affected by the paſſions of the mind, acting through the medium of its nerves, juſt as a palſied limb, immoveable by cool volition, is ſometimes acted upon by the violent emotions of fear, or anger ſuddenly produced: yet the palſied ſtate remains after this violent excitement ceaſes. A paralytic limb has ſometimes reſumed power to convey off perſons violently alarmed by fire: a paralytic arm has been ſtimulated by the ſudden tranſport of an affront to give a blow. In this manner the energy of paſſion agitates the heart by the medium of the cardiac nerves, though it remains unaffected by cooler volitions.——Beſides this direct force of paſſion, the nerves of the heart are alſo in a thouſand different ways, indirectly affected by the paſſions of the mind. Their influence is felt in every part, in every nerve and muſcle. Breathing is accelerated, or as it is expreſſed, ſhortened, the muſcles of reſpiration are quickened in their contractions; the ſtomach rejects its contents;

pletes the proof of the uſes I have here aſſigned to the Ganglions of the nerves.

It is objected, "That one or two Ganglions are "often obſerved upon a filament of the ſecond "great branch, and another upon the third branch "of the fifth pair of nerves."

The conſtancy, and, if I may ſo expreſs it, the ſolicitude with which all parts whoſe motions are involuntary, are provided with nerves, furniſhed and beſet with Ganglions, and the great ſcarcity of them on nerves detached to muſcles ſubject to our volitions, and the total want of them on the ſenſory nerves, ſufficiently beſpeaks their general deſtination and uſe; notwithſtanding a few ſeeming exceptions: ſeeming, I ſay, becauſe thoſe few alledged as ſuch, are not permanent parts of animal ſtructure, or conſtantly found. As their appearance is in ſome meaſure accidental, we have reaſon to ſuſpect

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tents; and the biliary ducts throw out their liquors: the kidneys and bladder are ſtimulated to frequent evacuations, the limbs univerſally tremble, and the countenance grows pale and reddens by turns. In an agitation which is more or leſs univerſal, the heart is acted upon directly through the medium of its proper nerves, but likewiſe indirectly by ſympathy; whence the affections of every external and internal part re-act upon it: the blood accelerated in its movement, as appears by the pulſe, often acquires a feveriſh velocity during the act and influence of paſſion, wherein the quickened motions of the heart, muſt correſpond with the rapidity of the blood's movement. In ſuch various ways do the paſſions act upon the motions of the heart through the medium of its nerves.

ſuſpect them ſometimes to be rather morbid phænomena, than organs of great importance in the animal ſyſtem: the ganglia in particular of *Mekelius*, found on the ſecond and third branches of the fifth pair of nerves, are very eſſentially diſtinguiſhed by Baron *Haller* from other Ganglions; particularly the Ganglion ophthalmicum, which, he ſays, is conſtant and perpetual; whereas the other Ganglions of the fifth pair are not ſo, for he remembers to have examined bodies, in which they were wanting.* But, ſuppoſing the utmoſt in favour of the conſtancy of theſe ganglia of the fifth pair, the nervous twigs on which they have been obſerved, being chiefly diſtributed to the ſalivary and mucous glands, about the jaws, tongue, palate, throat, and noſtrils, may they not be ſuppoſed to have ſome uſe in glandular ſecretion? For we ſee the glandular parts in the abdomen, are ſupplied by the great ſympathetic nerves, as well as the muſcular fibres of the heart and inteſtines.

Soon after my papers on the uſes of the Ganglions

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* Theſe Ganglions have been ſeen on a twig of the ſuper-maxillary branch of the fifth pair, with reſpect to which Baron *Haller* ſays, "Memini in aliis Cadaveribus eodem loco nullum adfuiſſe." El. Ph. T. iv. p. 213. The ſame he obſerves with reſpect to another Ganglion, ſometimes ſeen on the lingual branch of the third great branch of the fifth pair, the maxillaris inferior, it was ſometimes not found. Ibid. T. iv. p. 218—219. The pterygoid branch, on which a third Ganglion has been ſeen, ſends one or two twigs to unite with the intercoſtal nerves at its origin.

glions of the nerves, appeared in the Phil. Tranſ. 1764, the applatiſement, or remarkable plexus on the trunk of the fifth pair of nerves, was, by *Gaſſerius*, a profeſſor of anatomy at Vienna, noticed as a Ganglion, overlooked by former anatomiſts: overlooked, indeed, as a Ganglion, it had been; nor has its pretenſions and exiſtence as ſuch been ſince admitted. I have examined the recent ſubject, and find the fifth pair of nerves, as it dips under the dura mater, and immediately before its diviſion into three principal branches, is ſubdivided into leſſer cords, in like manner as the cauda equina, in the lower part of the ſpinal marrow, is divided before its final ſeparation in diſtinct nerves.

The diviſion of theſe cords in this pair of nerves, is made by cellular fibres under the dura mater, occaſioning that remarkable flat enlargement of the nerve, well repreſented in the figure of *Wriſberg*, juſt before the three great diviſions go off in ſeparate foremina. This had been noticed by *Winſlow*, the elder *Monro*, and *Haller*. *Gaſſerius* firſt called it a Ganglion, and that immediately upon the publication of my paper. His doctrine appears to have been ſupported by his ſcholars, but is generally rejected by later anatomiſts.

Dr. *Monro* is the only writer of reputation, who, ſo far as I know, conſiders it as a Ganglion, and objects it to my doctrine, in the note in page 58 of his work, already referred to: and, in endeavouring to ſupport his opinion by authority, he makes an unlucky reference to *Wriſberg*'s deſcription of the fifth pair of nerves, who employs a chapter to demonſtrate *that it is not a Ganglion*: and I concur with him. — The following are *Wriſberg*'s words: "Multum noſtris temporibus diſputatum eſt de ganglio formi quinti paris, ante ſuam in tres ramos diviſionem, intumeſcentia, quam in memoriam vindobonenſis prof. *Gaſſerii* Ganglion a variis appellatur.——*Omnia e contrario argumenta conſpirant, ut confidenter et certo aſſerere audeam, merum plexum eſſe*, et *illaqueatam nervorum filamentorum conjunctionem*, quod *Gaſſerii* Ganglion alias audit, & quod a figura intumeſcentia ſemilunaris convenienter appellari deberet." Vide *Wriſberg* de quinta pari nervorum, ſect. 2. De intumeſcentia ſemilunari. Supported by this authority, as well as *Autopſia*, I do not admit that this is a Ganglion,

It has likewiſe been objected, "That the great "ſympathetic nerves ſend ſome branches to parts, "under the controul of the will, as the pharynx "and diaphraghm, as well as to the heart and in"teſtines, not ſubject to that controul."

It is well known, that though the pharynx derives ſome nerves from the great ſympathetic

nerves,

nerves, its moſt conſiderable ſupply of nerves comes from the eighth pair: and the diaphragm is rendered paralytic by tying or cutting the phrenic nerve diſtributed to it; which ſhews that its motions have very little dependance on the minute filaments which it receives from the great ſympathetic nerves. There are other motions in theſe parts, beſides thoſe of the voluntary kind; theſe motions being of the *mixed* kind, ſometimes being *involuntary*, at others voluntary. There are other parts alſo, as well as theſe now named, whoſe motions are of the mixed kind; and it is remarkable that all of them have two different kinds of nerves; namely, ſome without Ganglions to ſubject them to the powers of volition, and others that have Ganglions to ſupply the involuntary motions of the ſame parts. Thus the diaphragm moves, when we are aſleep, and when we are awake, though not quite ſo often; and continues to move, though leſs frequently, even during a profound apoplectic fit. In like manner, we can raiſe the pharynx by an effort of the will; yet in the actions of deglutition, its motions are chiefly involuntary, from the ſtimulus of the food paſſing down the gullet.* In the involuntary motions, the ſtimulus which excites, regulates their intenſeneſs and continuance:

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* See Eſſay on the Vital and Involuntary motions of Animals.

ance: in the voluntary motions, the will excites and regulates them all.

We are not to imagine, nor do I know that it is generally ſuppoſed by anatomiſts, that whereever the nerves unite, their medullary ſubſtance either decuſſates, or is ſo intimately mixed, as is reaſonably ſuppoſed to be the caſe in Ganglions, by moſt anatomiſts, from *Gliſſon* down to *Haller*: we know at leaſt, that this is far from being the caſe in the *optic* nerves; for though they unite, and were ſuppoſed to croſs each other, the contrary appears by obſervations, made in the bodies of perſons who were blind of one eye from a fault of the optic nerve; the nerve of the affected ſide only being waſted, while the other was large and plump.* And we may juſtly infer, the *Plexiform unions* of the nerves, diſtributed to the ſuperior and inferior extremities, not to be more intimate, nor intended to ſerve any ſuch purpoſe as Ganglions, ſince theſe nerves are equally motory and ſenſory; no other nerves being diſtributed to the ſkin, the organ of touch, but from the ſub-diviſion of theſe plexuſes.

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[*] See the anatomy of the nerves in general, by a late juſtly celebrated profeſſor of anatomy, Dr. *Monro*, ſen. p. 356. and No. 23. *Santorini* obſ. Anat. 63. *Veſalii* Anatom. Lib. iv. C. iv. "*Veſalius, Aquapendens,* "*Valverda* aliquando obſervarunt, toto ductu diviſos opticos nervos man-"ſiſſe, & eum tamen in quo ſic conſpexit *Veſalius* de viſu nunquam con-"queſtum fuiſſe, viſuque præſtanti ſemper valuiſſe." *Morgagni* de ſedib. Morb. Ep. xiii. Art. 7.

SECT. IV.

Phyſiological difficulties obviated. Conjectures concerning irritability, muſcular motion, ſympathy, &c.

IF theſe anatomical difficulties do not ſubvert our doctrine, the following of a phyſiological nature, it is preſumed, will not be more formidable; or perhaps may become arguments in its favour, when properly conſidered.

It has been objected, "That if the Ganglia intercept the communication between the ſenſorium commune, and thoſe parts whoſe nerves "are derived from them, they ought not only to "intercept the commands of the will, and render "the motions of theſe parts not voluntary, but "they ought alſo to prevent the impreſſions made "on the nerves of theſe parts, from being conveyed to the ſenſorium commune; *i. e.* theſe "parts ought to be inſenſible: the contrary of "which is true. For example, the inteſtines, "whoſe nerves come from Ganglia, are among "the moſt ſenſible parts of the body: and if the

" uneaſy ſenſation in the lungs, in aſthmatic caſes,
" was not conveyed to the ſenſorium commune,
" how could the will redouble the action of the
" diaphragm and the intercoſtal muſcles?"

I. To this it may be anſwered, that an anaſtomoſis, or new arrangement of the nervous filaments which appears to take place in Ganglia, may intercept the efforts of the will, and alſo render the ſenſations of parts wholly ſupplied with nerves from Ganglions, leſs determinate and preciſe than in other parts, which indeed is a fact; yet, without rendering ſuch parts totally inſenſible. Paralytic diſeaſes ſhow, that the nerves may be ſo affected, as to be incapable of conveying the commands of the will, and yet remain ſufficiently capable of reconveying ſenſible perceptions. In the palſies which are moſt frequent, the parts rendered perfectly immoveable by the diſeaſe, have as quick a feeling as thoſe that are moveable by the will; and what deſerves attention, are often moved involuntarily, eſpecially upon the application of any painful ſtimulus: and it is obſervable too, that paralytic limbs, which are not to be moved by our volitions, are often called into action, when the paralytic perſon is ſuddenly thrown into any violent paſſion; juſt as we obſerve the ſame cauſe to produce extraordinary commotions in the heart and inteſtines, &c. though the will, coolly exerted, has no power over theſe parts.

II. Various obſervators have ſhown that the feelings of the organs, whoſe motions are involuntary, are by no means exact, nor always acute. We have it on the authority of *Harvey*,* confirmed by Baron *Haller*, that the heart, though highly irritable, is when touched, very dully ſenſible, as has alſo appeared in wounds and contuſions of this part.† *Haller* aſſerts that the lungs, liver, ſpleen, and kidneys, all ſupplied from the great ſympathetic nerves, have been cut in pieces, and yet the animal ſeemed to feel no pain. And (which is a proof leſs liable to exception) operations and diſeaſes in the kidneys, and ulcers in the lungs being but little painful, ſhow the feelings of theſe parts not to be exquiſite.‡

III. The ſtomach, which has a very large portion of the eighth pair of nerves beſtowed upon it, loſes its ſenſibility and contractile power ſo perfectly by ligatures of this nerve, that the food neither paſſes down the œſophagus, nor is concocted in the ſtomach; and by ſpontaneous corruption there puts on the appearance of the fæces themſelves, ſo fætid in the large inteſtines.[*] 'Tis in conſequence of the ſenſibility which the ſtomach derives by means of this nerve, along with its peculiar organization, that the ſtomach becomes the principal ſeat of hunger; and, to uſe the words of a celebrated writer, "As it is affected with a more diſagreeable ſenſation, when we have wanted food for any conſiderable time, than the guts; ſo likewiſe it is more ſenſible of an agreeable feeling, from grateful food: and in theſe reſpects it may be ſaid to be *more ſenſible* than the inteſtines."[†]

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* *Harvei* de Generat. Animal. † Phil. Tranſ. Vol. lii.

‡ *Haller*'s celebrated Eſſay on ſenſible and irritable parts.

IV. A leſs preciſe feeling the inteſtines certainly have; and though in many inſtances they are the ſeat of exquiſite pain, yet in conſequence of the *connexions* of the nervous filaments in the Ganglions, any painful diſeaſe ſeated in the inteſtines, or in the other viſcera contained in the abdomen, is by ſenſation leſs determinable to its particular ſeat, or rather is more apt to affect the parts adjoining, than diſeaſes of a painful nature which are ſeated in the ſtomach itſelf, and in other parts whoſe nerves are not ſupplied with Ganglions.[‡]

And

[*] See *Morgagni* & *Vieuſſens* locis citatis.

[†] See *Whytt*'s Path. Eſſays, p. 155, firſt Edit.

[‡] Ut anima non adeo accurate locum dolentem diſtinguat, ſed obiter utcunque, et aliqua latitudine. A. V. *Haller* El. Phyſ. T. iv. p. 407.

And this leads us to a natural ſolution of that ſympathy, that *intercommunion of ſenſations, or, that imputation of painful ſenſation*, which ſo frequently takes place in the cholic, inflammation of the inteſtines, and nephritic complaints, and other diſeaſes of the contained parts of the abdomen, from which ſome writers * have very concluſively argued for the neceſſity of ſuch a communication of the nervous filaments in Ganglions, as appears indeed, to take place in them, and which, among other important uſes and conſequences, ſeems the occaſion of many of thoſe ſympathetic ſenſations in the lower belly, ſo frequently taken notice of, and ſo difficult to be explained.†

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* *Zinn.* de oculo, citat. *Haller*, El. Phyſ. T. iv. p. 321.

† The celebrated *Whytt*'s objections to particular ſympathies, ariſing from a connexion of nerves in Ganglions, ſeem inconcluſive: for, ſays he, ſuch a communication as is ſuppoſed in Ganglia to occaſion ſympathy, would cauſe *a confuſion* in our ſenſations, as well as in the *motions* of our muſcles. With reſpect to *ſenſation*, we have ſeen that *confuſed* or *indeterminate ſenſation*, is proper to parts whoſe nerves ariſe from Ganglions; and that the muſcular motions of theſe parts are not regulated by the will, but by the application of an irritating cauſe; and therefore, inſtead of proving that ſympathy in the abdominal viſcera does not ariſe from Ganglions, they render it likely that it does. The mind undoubtedly feels ſympathetic, as well as all other ſenſations, only at the origin of the nerves in the brain, where the ſoul ſits enthroned: yet facts incline me to think with *Willis, Vieuſſens, Haller*, and *Monro*, that *ſympathy* depends in *many caſes* upon the *connexions* of nerves *in their courſe*, as well as *at* or *near* their *origin*.

It is objected alſo, " That every voluntary
" muſcle in the body becomes involuntary when
" it is ſtrongly ſtimulated: for example, the *ac-*
" *celeratores urinæ*, are quite *voluntary* in the ac-
" tion of *expelling the urine*, but act *involuntarily*
" in *expelling* the *ſemen*."

When we conſider the ſtate of the ſoul and body under any violent paſſion of mind, we find the uſual operations of the ſoul itſelf are not only diſturbed, but thoſe parts of the body too, which the will cannot controul, are now agitated by the ſtorm; for every one has experienced that the heart and viſcera in general are vehemently affected by ſtrong paſſions: the mind is in like manner violently re-acted upon by very ſtrong bodily ſenſations;

It is well known, that an irritating cauſe acting upon a nerve in any of the limbs, will ſometimes extend its efficacy as far back as the brain, and occaſion *convulſions*, or epileptic paroxyſms affecting the whole body ſympathetically; at other times it only affects ſome particular parts of the body, as in the caſe of the locked jaw, ſpaſmus cynicus, and various other inſtances which I purpoſely omit. In like manner any violent irritation, which by its ſtimulus affects any of the filaments of the intercoſtal nerves up to their origin in their reſpective Ganglions, will alſo act by conſent upon, and affect all the filaments which have their common origin in ſuch Ganglions: and hence ſympathetic ſymptoms will ariſe in the firſt place, in the parts of the abdomen and thorax ſupplied by the great ſympathetic nerves, and afterwards in the reſt of the body, nearly in the order in which theſe nerves are connected with the reſt of the nervous ſyſtem. The reader will find that the celebrated *De Haen* has adopted the *Winſlowan* opinion, that the Ganglions are the origin of the intercoſtal nerves, and attempts with great probability to explain from thence the ſingular ſations; for it is well known that muſcular parts which are ordinarily ſubject to our volitions, ceaſe to be ſo, if any part is ſtimulated by exquiſitely pleaſing, or exceſſively painful ſenſations; under ſuch a ſtimulus they are neceſſarily contracted or convulſed. But, it is not therefore to be concluded, that the gentle ſtimulus of the blood, on the internal ſurface of the heart, and of the air, food, and gaſtric juices, on the inteſtines, of which the mind has no conſcious perception at all, much leſs a diſagreeable one, can lay it under any ſimilar neceſſity, as ſome have argued. This objection can have no force againſt our doctrine, however it may recoil upon that of others; as all voluntary muſcles whatever may be excited to contractions by irritations exceſſively pleaſing or painful; the contractions from ſuch cauſes being involuntary, neceſſary, and uncontroulable:

ſingular paralytic ſymptoms ſometimes left by the ſaturnian cholic. This general account of ſympathy is ſupported by ſo many facts, that I think one may ſafely venture to foretel, it will derive proof and confirmation from ſuch new diſcoveries as will advance the knowledge of the nerves, and enable future ages to ſee things clearly on this ſubject, which at preſent are dark and inexplicable to us.

In, univerſum quidem nervorum ſyſtema nexum quendam & communicationem ſervant. Oculorum paria, cum inter ſe, tum mediante 5to, 7mo, multiplici ratione conjuncta ſunt, octavum mediante intercoſtali, cum omnibus ſpinalibus, phrenico, et nonnullis cranii conjunctum: præcipuum autem totius ſyſtematis nervoſi perficit nexum intercoſtalis, qui primos fere cranii nervos, cum ultimis in ſacro oſſe exeuntibus nectit. Caput itaque truncum, artuſque in unum conjungit. *H. A. Wriſberg.* De Ganglio & Plexu ſemilunari in Abdomine, Com. Gott. 2 vol. 1780.

controulable: but the ſtimuli that affect the heart and other parts, whoſe motions are naturally involuntary, are not of this claſs, nor of this ſtrength; and indeed, are ſo little perceived by the mind, as to lay it under no ſuch neceſſity, as in the inſtance objected. Thoſe on the contrary, who, obſerving that we are not conſcious of theſe motions, infer from thence, that the ſelf-thinking individual or human ſoul, is not the real author of them; and who, inſtead of referring them to unknowing nature, attribute them ultimately to its great Director, ſeem to me, to reaſon very concluſively.*

To what other immaterial power can we refer the ſupport of the vital motions, which have for their cauſe irritability? A principle or cauſe not immediately extinguiſhed by death itſelf, and which exiſts in the heart and inteſtines, not only when

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* See *Baxter*'s inquiry into the nature of the human ſoul. A performance in which the juſteſt notions of the ſoul's authority in and over our bodies, and of the divine government co-operating therein, and controuling univerſal nature, are excellently deduced and ſupported upon the foundations of ſound reaſoning and true philoſophy.

" The great myſterious Being, who made and governs the whole ſyſ-
" tem, has ſet a part of the chain of cauſes in our view; but we find,
" as he himſelf is too high for our comprehenſion, ſo his more immediate
" inſtruments in the univerſe are alſo involved in an obſcurity that philo-
" ſophy is not able to diſſipate; and thus our veneration for the ſupreme
" Author is always increaſed in proporion as we advance in the know-
" ledge of his works: as we arrive in philoſophy towards the firſt cauſe,
" we

when they are ſeparated from the head, and the reſt of the body, but when divided into a thouſand parts, each piece retains it.

Is it then an inherent property of muſcular fibres? Sound philoſophy teaches us, that activity in matter can never be inherent, but muſt be impreſſed by ſome immaterial, and as ſeems probable, in the preſent caſe, active percipient power.

As irritability exiſts in muſcular fibres ſeparated from the body, the ſoul does not ſeem to be that active power. For the ſoul is ſeated in the brain only, and is acted upon, and puts muſcles in action, by means of nerves (*Prop.* 4, 5.) continued from the brain. Hence when the nerves are compreſſed, tied, or cut through, the ſoul loſes its power, and yet, irritability remains, even in muſcles

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" we obtain more extenſive views of the conſtitution of things, and ſee " his influence more plainly: we perceive that we are approaching to " Him, from the ſimplicity and generality of the laws or powers we diſ" cover, from the difficulty we find to account for them mechanically, " from the more and more complete beauty that appears, &c." *M'Laurin's* View of Sir *Iſaac Newton*'s Philoſophy. Cap. 1.

The following paſſages from *Cudworth*'s Intellectual Syſtem, will, perhaps, induce my readers to look into an excellent old book. " As we " have no voluntary imperium at all, upon the ſyſtole and diaſtole of the " heart, ſo are we not conſcious to ourſelves of any energy of our own " ſoul that cauſes them, and therefore we may reaſonably conclude from " hence cles of the voluntary claſs. Thoſe that are involuntary, and over which the ſoul has no authority at any time, poſſeſs this property nevertheleſs, in the moſt eminent degree.

Detruncations of the body, diminiſh not the faculties of the ſoul, which remain perfect unleſs the brain be injured. The ſoul is not a diviſible or diſcerptible ſubſtance.

Irritability therefore, though capable of being occaſionally excited by the ſoul, as a kind of irritant, through the medium of the nerves, ſeems to have a different percipient agent for its cauſe, and to be derived only from that immaterial Being, who created all bodies, is the ſource of all active force that appears in them, and preſides over the univerſal frame of nature.

I ſhall

" hence alſo, that there is ſome vital energy, without animal fancy or " ſynœſthefis, expreſs conſciouſneſs and ſelf-perception." P. 61.

" In the efformation of the bodies of animals, it is one and the ſelf- " ſame thing that directs the whole; that which contrives and frames the " eye, cannot be a diſtinct thing from that which frames the ear; nor " that which makes the hand, from that which makes the foot; the ſame " thing which delineates the veins, muſt alſo form the arteries; and that " which fabricates the nerves, muſt alſo project the muſcles and joints; " it muſt be the ſame thing that deſigns and organizes the heart and " brain, with ſuch communications betwixt them; one and the ſelf-ſame " thing muſt needs have in it, the entire idea and the complete model " or platform of the whole organick body. For the ſeveral parts of mat- " ter diſtant from one another, acting alone by themſelves, without any

" common

I ſhall not enlarge this digreſſion, by endeavours to explain how the *ſoul* acts upon the *nerves*; and how, by means of theſe, the irritable muſcular fibres are, by an act of the will, made to contract: how the more violent agitations of the ſoul, by the medium of the nerves, affect the irritable, but involuntary vital organs. What the nerves contribute towards the contractions of *muſcular fibres*, and how far their efficacious energy is neceſſary to ſuch contractions, (ſee Prop. 6.) Of theſe we ſay, in the words of *Pliny*, L. 2. C. 37. Omnia incerta ratione, & in naturæ majeſtate abdita.

There is in all fibres of animal bodies, even thoſe of the cellular kind, a natural contractibility and power of retraction, which appears equally in living and dead bodies, whether warm or cold.

Muſcular fibres poſſeſs this power of retraction along

"common directrix, being not able to confer together, nor communicate with each other, could never poſſibly conſpire to make up one ſuch uniform and orderly ſyſtem and compages, as the body of every animal is.—It muſt be one and the ſame thing, which forms the whole, or elſe it could never have fallen into ſuch an uniform order and harmony. Now that which is one and the ſame, acting upon ſeveral diſtant parts of matter, cannot be corporeal." P. 163.

"If there be a plaſtic nature, that acts regularly and artificially in order to ends, and according to the *beſt wiſdom*, though itſelf not comprehending the reaſon of it, nor being clearly conſcious of what it doth, then there muſt of neceſſity be a *perfect mind* or *intellect*, that is, a DEITY upon which it depends." Ib. p. 172.

along with that of irritability, which ſeems proper to them alone, in their living ſtate; at leaſt, it vaniſhes ſoon after death, and is not capable of being excited when muſcles are thoroughly cold, in conſequence of death.*

This property of irritability in muſcular fibres, ſeems not only capable of being excited and regulated by means of the nerves, but is alſo manifeſtly capable of increaſe by nervous power: yet polypes, and perhaps ſome of thoſe plants called ſenſitive, are highly irritable, though ſaid to be deſtitute of nerves: if this aſſertion be ſufficiently grounded, it would then ſeem, that irritability has no neceſſary dependance upon nerves, but may exiſt in muſcular fibres without them. This property, however, in muſcular fibres, in connexion with nerves, is productive of voluntary motion at the nod of the mind; and is alſo productive of involuntary motion, by the action of a ſtimulating fluid, upon the nerves ſpread over the internal ſurface of the heart and inteſtines; ſo that, though we may have animals formed without nerves, highly irritable and active, in conſequence of this irritability; yet, in ſuch animals as have the nervous and irritable ſyſtems united, the dependance of irritability upon

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* Te deciſa ſuum, Laride, dextera quærit,
Semianimeſque *micant digiti*, ferrumque *retractant*.

Virg. Æn. x. 395, 396.

the nerves, in conſequence of that union, ſeems ſo great, as not eaſily to be, even in imagination, ſeparable from them.

What we know only with certainty is this ſingle fact; that the nerves connect the ſoul and the body together: that by them the ſoul acts, and is acted upon: how theſe things are performed is entirely unknown to us, and will probably ſo remain, at leaſt, till new diſcoveries are made in the nervous ſyſtem.

Though no poſitive doctrine of any great importance has yet been educed from the late reſearches and experiments, concerning the nature of the irritable fibres of animals and their nerves, theſe reſearches ſhow that many things hitherto firmly believed concerning them, are merely ſuppoſititious. From the effects of ſtimuli on the nerves and muſcular fibres, from the excited contraction bearing no proportion to, and often far exceeding, the force with which the ſtimulus was impreſſed; in fine, from the evident marks of life, and ſomething reſembling ſenſibility, in theſe contractions, it ſeems clear, that the origination of muſcular action is not likely to be accounted for by any hydraulic law or mechanic power: and the ſuppoſitions of ſubtile fluids called *ſpirits*, flowing in nerves as canals, or of an electric aura *conducted* by them, or of vibrations like elaſtic ſtrings, are not only aſſumed without proofs, but are all equally inapplicable, in all points to appearances, and inſufficient to account for the communication of motion from the brain to the muſcles.

To unfetter the mind from error, prepares it for the inveſtigation and diſcovery of truth. A real conviction of the imperfection of our knowledge of the nerves, which has of late been gaining ground and acquiring ſtrength from many laudable attempts to remove thoſe defects, affords a happy preſage that the acquiſition of true and important knowledge, in this dark region of animal ſtructure, is not far off. Yet we muſt remember, that ſcience may be defective, when it is not illuſory or totally falſe. For in the firſt gleams of light, and the firſt conceptions of truth itſelf, concerning ſubjects that border on the limits of human knowledge, difficulties will abound; and the darkneſs, which terminates our proſpect, muſt neceſſarily cloud and obſcure its confines.

Laſtly, it has been objected, " That though " the motions of the uvea are involuntary, from " light affecting the eye, they are truly voluntary, " when it contracts in order to the diſtinct viſion " of an object placed near the eye, whoſe minute " parts we want to obſerve accurately."

It is an excellent *maxim* laid down by Sir *Iſaac Newton*, that "Concluſions drawn from experi-"ments and obſervations by induction, are not "to be ſhaken by any objections but ſuch as are "taken from experiments, or other certain truths." The diſtinction formed in this objection is the offſpring of the ſchool of *Stahl*, and has no ſupport from experiment and obvious matter of fact; but ſeems verbal and hypothetical only. This will appear, if we conſider that the uvea always dilates, when the diſtance of an object increaſes, and in an obſcure light. Dilatation is the natural ſtate of the pupil, and a faint image or weak light making but little impreſſion upon the retina, and a ſtrong light and near object (which always reflects a more vivid image than a diſtant one) making a ſtrong impreſſion upon it, the pupil is more contracted by the laſt, and leſs by the firſt. That the contractions of the pupil are never voluntary, but always ariſe from ſenſations of the retina, uniformly and involuntarily, by an invariable law, appears by experiments and diſeaſes: and hence it is, that the pupil conſtantly becomes immoveable and greatly dilated, when by a gutta ſerena the retina becomes inſenſible. The great man, to whoſe precious ſtores we have been ſo often indebted in the courſe of this inquiry, has furniſhed experiments, which prove that the iris or uvea, like all other parts provided with nerves from Ganglions, has but a dull degree of feeling, and is moved intirely independent of the will. " What perſuades " me, that the iris is much leſs ſenſible than the " retina, is, that if, after having pierced the cor- " nea, you irritate or cut the iris, it is not there- " fore contracted; whereas the leaſt increaſe of " light makes it contract: which evidently proves " that this contraction does not depend upon the " proper ſenſibility of the iris, but on the retina: " the gutta ſerena ſerves to prove the ſame thing; " the iris being no ways changed in that diſeaſe, " any farther than it is deprived of motion from " the ſenſation of the retina being deſtroyed by a " palſy of the optic nerve."* And whoever will obſerve the motions of the pupil by means of a mirrour, will find the will has no ſort of power over them.

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* See Baron *Haller*'s Eſſay on Irritability, p. 31. and Element Phyſ. T. v. p. 374—378.

SECT. V.

Late experiments on animal electricity: additional proofs.—Summary view, and concluſion.

IT will be expected that I notice the experiments of *Galvani*, *Volta*, Dr. *Valli*, and Dr. *Fowler*, on animal electricity, and their connection with my ſubject.

On the whole it appears to me, that an electrical exploſion produced by the approximation of two metals, one of which is in a negative, and the other in a poſitive, ſtate of electricity, conducted by the nerves, acts as a ſtimulus on the muſcular fibres. This electrical fluid is indeed inconceivably penetrating and active; and the medullary ſubſtance of the nerves is found to be an excellent conductor of it. But ſtill its action ſeems analagous to that of other extraneous ſtimuli, and like them to be impeded by the Ganglions.

In theſe intereſting experiments, ſo far as they have come to my knowledge, it appears that the effects of the influence of the metals are confined to the nerves appropriated to the muſcles of voluntary motion: and that the heart, through the medium of its nerves, is not excitable by the ſame means which are found efficacious in exciting other muſcles. In this *Galvani*, *Volta*, and Dr. *Valli* agree.*

Dr. *Fowler* has proſecuted this inquiry with much ingenuity, and repeated, as well as varied, theſe experiments, with great induſtry: he ſays, "I ſurrounded with tin-foil the par vagum and intercoſtal nerves of ſeveral cows and ſheep, while the auricles of their hearts were ſtill contracting, and placed one end of a bent ſilver rod, at one time upon the heart itſelf, at another, upon adjacent muſcles, and ſometimes upon the nerves, but all without producing the ſlighteſt variations, in the contractions of the heart, or a renewal of them when they had ceaſed." *Fowler* on An. Elect. p. 70.

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* See Phil. Tranſ. p. 1,—1793.——and Dr. *Valli* on Animal Electricity.

Dr. *Monro*'s experiments, on animal electricity, &c. which I had not read till this ſection was prepared for the preſs, clearly decide that the fluid or influence from the metals, is electrical or ſimilar to it: that it is not the nervous fluid, but operates as a ſtimulus on the nerves, and by their medium only on muſcular fibres.—If the involuntary muſcles had been thus put in motion, notice, moſt probably, would have been taken of it by this accurate obſerver.

" I had as little ſucceſs when I made ſimilar experiments upon a dog, cats, rabbits, fowls, and frogs; yet in all theſe animals, I could in general excite vigorous contractions by arming the nerves of parts obedient to the will." (Ibid.)

After Mr. *Fowler* had obſerved the ſuperior powers of zinc and molybdena in exciting contractions, he endeavoured to excite them in the involuntary muſcles, by applying rods of zinc and ſilver to the nerves of the heart in frogs: and he ſucceeded in exciting contractions, when the metals were applied to the nerves very near the heart and after opening the pericardium, and to the heart itſelf taken out of the body lying upon a plate of zinc.

In theſe experiments the ſtimulus appears to have acted either on the ſubſtance of the heart, or its nerves and veſſels, in a very near approach to its ſubſtance, below the Ganglions, in a manner analagous to the well-known action of chemical and mechanical ſtimuli, applied to that moſt irritable organ.

In other experiments he ſays, " I could not obſerve

ſerve that any contractions were produced in the ſtomach or inteſtines by placing the metals near the ſtomachic plexus and ſemilunar Ganglion in a cat."

With reſpect to the contraction of the iris produced ſimultaneouſly with the flaſh of light by the union of metals; that flaſh is excited in poſitions of the metals ſo various, on the lips, face, and noſtrils, that there ſeems no ground for concluding that the effect of the contact of the metals paſſes through the lenticular Ganglion, to the retina, conſidering the diffuſive penetrating nature of the electric fluid, and that there are ſo many other nerves and means of conducting of it: particularly when it is remembered, that mere rubbing in the dark, and preſſing the globe of the eye, and the parts contiguous to it, cauſe a ſimilar ſenſation of light; and that, by an eſtabliſhed and invariable aſſociation, the iris always contracts from the ſenſation of light, from whatever cauſe it may be excited.

Thoſe who candidly make truth the object of their purſuit, will ſee in theſe experiments new ſupport to the doctrines of this Eſſay, and in it a clue to explain theſe experiments, and the conſequences deducible from them, in which they are in harmony with other phyſiological facts.

If the ſubtle electric fluid, for ſuch it appears to me, had, in theſe experiments, really paſſed through the Ganglions, and produced contractions in the involuntary muſcles, concluſions drawn from anatomical and phyſiological facts, that theſe muſcles are rendered involuntary by intervening ganglia, would not have been thereby invalidated. But on the contrary, as voluntray muſcles only are ſuſceptible of contractions, by the application of the two different metals to their proper nerves, it ſeems reaſonable to conclude, that the mechaniſm in Ganglions, by which volitions are interrupted, alſo prevents the influence of the two metals, as it does other ſtimuli, applied above the Ganglions, from exciting contractions in the involuntary muſcles: and when ſtimuli, or, thoſe metals are applied below Ganglions, and immediately touch theſe involuntary muſcles, or the nervous matter intimately commixed with their fibres, they being highly irritable, contractions will be excited and renewed in them at pleaſure.

Dr. *Valli* finds ligatures on the nerves, interrupt the communication of the electric influence to the muſcles: and alſo that the fluid has much leſs affinity to the coats of the nerves, than to their medullary ſubſtance; and that it is principally conducted, by the proper nervous ſubſtance, to the correſponding muſcular fibres.

As in Ganglions the nervous ſubſtance appears to be intimately intangled in cellular ſubſtance greatly indurated, does not this ſtructure, though imperfectly underſtood, ſhew how the electric influence is interrupted in Ganglions, and ſuggeſt, by the analogy of ligatures, the means which interrupt volitions, from acting upon the involuntary muſcles?

Theſe unſought and accidental proofs of my opinion, make it in no ſmall degree probable, that no real advance will hereafter be made, in the phyſiology of the nerves, which will not in one reſpect, or another, confirm our doctrine.

On the whole, whether we conſider the functions of the parts, on whoſe nerves the Ganglions are conſtantly ſeated, or that of thoſe which are deſtitute of them, whether we conſider what has been advanced in favour of our doctrine on the uſes of the Ganglions, or what with equal impartiality we have ſtated as having been objected to it, by ingenious and learned perſons, there reſults a ſurplus and preponderance of evidence and argument, clearly evincing that the internal motions, of the principal organs of life, are involuntary, by the means of the Ganglions ſeated on the nerves diſtributed to them.

I add to this ſummary view, the following extract from a paper, which the ingenious author permits me to inſert in my work. The argument being compreſſed into a narrow compaſs, and expreſſed with equal clearneſs, and force in it, will leave its impreſſion with my readers.

" It is known that the nerves are the inſtruments of ſenſation and motion, by their conſtant diſtribution to the organs of ſenſation and motion: in like manner the Ganglions conſtantly attending the nerves diſtributed to the organs of involuntary motion, and, in a more accurate anatomy of the nerves, not being found on nerves appropriated to ſenſation and voluntary motion. It follows by induction, that they are thence aſcertained to be the means by which the involuntary motions are independent of the will, with the ſame kind and force of evidence, nerves without Ganglions, are known to be the inſtruments of ſenſation and voluntary motion.

" The importance of this diſcovery was felt by *B. Haller*, and other anatomiſts, but was treated with ſome degree of that jealouſy, with which diſcoveries in anatomy are generally received: objections have been repeated, which were obviated in Dr. *Johnſtone*'s Eſſay. The Ganglion, as it has been erroneouſly called, of the fifth pair was objected:

jected: but *Wriſberg*, in his work de quinto pari, demonſtrated that, to be no Ganglion, as in fact it evidently is not.

" The Ganglions on the ſpinal nerves were alſo objected. Dr. *Monro* demonſtrates that half of each of theſe nerves, does not paſs through, but ſlips on one ſide, of the ſpinal Ganglions. This removed the only difficulty, the only objection of force to this great diſcovery, and ought to have made Dr. *Monro* a convert to it; but anatomical prejudice is not eaſily overcome.

" As the ultimate ſtructure of a nerve is unknown, ſo that of a Ganglion is not ſufficiently unravelled to explain *how* it checks the operations of the mind. — The doctrine therefore reſts upon no hypotheſis, and is not affected by any thing advanced on the ſtructure of the Ganglions by *Monro*, *Meckel*, *Zinn*, and lately by *Haaſſe*, as ſtated by the very learned *Tiſſot*; (ſee his Analyſis of Dr. *Johnſtone*'s Eſſay, Traite' des nerfs et de leurs Maladies, T. 1.) but has received, ſince it was firſt publiſhed, confirmation and additional evidence by its agreement with the anatomical figures and deſcriptions of *Wriſberg*, *Neubaver*, *Monro*, and *Walther* of Berlin: and hereafter it will be conſidered by poſterity as one important ſtep made in the knowledge of the nerves, after an interval of two thouſand years ſince they were firſt known to be the inſtruments of ſenſation and motion."

SECT. VI.

Some diſeaſes conſidered briefly with relation to Ganglions.

FROM what has been ſaid, I think it appears, that Ganglions are organic parts of great importance in the nervous ſyſtem, and animal machine. That they limit the powers of volition, will, I flatter myſelf, appear a doctrine fairly inferred, by an induction, little, if at all, ſhort of being complete. We may therefore venture, upon theſe grounds, to conſider ſome of the ſubordinate effects of Ganglions in our machine; ſome of which we have already hinted, and which, I doubt not, will be much more extended by thoſe who ſhall ſucceed me in this reſearch: the coaſt is diſcovered, and others, I hope, will gather its riches.

I have already had occaſion, in anſwer to an objection ſtated in Sect. IV. of this work, to prove that parts ſupplied by the ſympathetic nerves, have in general an unpreciſe, dull feeling, and appear

inſenſible

inſenſible in many important circumſtances of the animal œconomy. We have no conſcious perception of the ſtimulus of the heart, from the blood received into its auricles and ventricles, and none of that, which is going on in the inteſtines, and the organs of ſecretion. *Haller* and his ſcholars, in an immenſe number of experiments, prove inconteſtably the inſenſibility of the internal organs whoſe nerves have Ganglions. He even tranſiently ſays, " Ab ea unione (in Gangliis) nonnunquam ſuſpicatus ſum, ut anima non adeo accurate locum dolentem diſtinguat, ſed obiter utcunque et aliqua latitudine." El. Phyſ. T. iv. p. 408.—410. This moſt induſtrious phyſiologiſt, in his Eſſay on the ſenſible and irritable parts of animals, ſpeaking from experiments he tried, which alſo were repeated and confirmed by his ſcholars, has the following facts, which are ſo many proofs of my aſſertion.

" The heart, which is very irritable, has, he aſſerts, but a ſmall ſhare of ſenſation, and, upon touching it in a living perſon a fainting is occaſioned, rather than pain properly ſo called.

The ſtomach is ſenſible, the inteſtines much leſs ſo, and are not liable to ſuch violent pain, and yet they are more irritable.

We muſt not conclude that a part is ſenſible, becauſe it is irritable, for the cutting and tying of a nerve, which deſtroys the ſenſibility of that part to which it is ſent, does by no means deſtroy its irritability.

I divide the phrenic nerve, and irritate that ſection, which does not communicate with the brain, and has no ſenſation left, the diaphragm nevertheleſs is convulſed.

In the ſame manner by cutting the crural nerve of a dog, that limb is deprived of ſenſation; but if you irritate that part of the nerve which communicates with the muſcles of the leg, that leg ſo irritated, will be put into a trembling motion, demonſtrating the irritability of its muſcles."

Our illuſtrious author might very concluſively have added, that the experiment likewiſe proves, that the property of *irritability* depends upon the nerves diſtributed to the muſcles. But he had adopted the falſe principle, that it depended upon a vis inſita in muſcular fibres, and not upon the nervous matter ever preſent with them: I go on with our author's facts.

" I am fully convinced, from a great number of experiments, that the viſcera properly ſo called, viz. the lungs, liver, ſpleen, and kidneys, have very little ſenſation, ſeeing I have irritated them, thruſt a knife into them, and cut them in pieces, without the animals ſeeming to feel any pain. Hence ulcers in the lungs are not attended with any pain, and perſons have had ſtones in their kidneys for ſeveral years, without being ſenſible of pain from them.

" The glands in general have only an obtuſe ſenſation; hence ſcirrhous and incyſted tumours are ſo indolent.

" If you cut or irritate the iris, it is not thereby contracted, the increaſe of light alone makes it contract, by its ſtimulus on the retina. The iris is no way changed in the gutta ſerena, and is only deprived of motion, from the ſenſation of the retina being loſt by a palſy of the optic nerve. In the operation of couching for the cataract, the patient hardly feels the inſtrument, after the tunica conjunctiva and cornea are pierced through.

" It is almoſt needleſs here to add, our author's concluſion, that irritability takes place in the body, without the ſoul being ſenſible of it, and that it is not ſubject to the command of the will. For it may be excited after the head, the ſeat of the ſoul, is cut off, and after the heart, inteſtines, and muſcles are ſeparated from the body."

The following obſervations, which are more properly noſological, prove alſo that parts, whoſe nerves are inſulated from the brain by Ganglia, are to a conſiderable degree inſenſible, and, are always indeterminate in the ſenſations excited in them, even by ſtimuli of extraordinary force.

The celebrated *Harvey*, ex. 52. de Gen. An. gives the hiſtory of a large wound in the left breaſt of a young nobleman, which laid bare the point of the heart. In touching it, he was convinced of the inſenſibility of the heart. Some attempt to explain away this fact, by alledging the heart was hindered from feeling in this inſtance, by the membrane which covered it: *Harvey* had ſufficient diſcernment to have made the diſtinction, if there had been any foundation for it; and it may be obſerved, that a glove on the hand, a ſhoe, or the cloathing of any ſenſible part, does not make it inſenſible to preſſure, as the heart is ſuppoſed in this caſe to have been.

In conſequence of this inſenſibility, the moſt formidable diſeaſes lurk undiſcovered in the heart, and either ſlowly or ſuddenly deſtroy life: and are only known by diſſections, to have had their principal ſeat in the heart. This appears in a vaſt number of obſervations, for which I refer the critical enquirer to *Bonetus*, and the later anatomical collections of *Morgagni*, *Lieutand*, Dr. *Baillie*, and others.

Boerhaave was well acquainted with this fact, as well as ſome of the older phyſicians quoted by *V. Swieten*, Sect. 913: but the following paragraph is taken from *Boerhaave*'s prælectiones de morbis nervorum, p. 496. Nec etiam fit dolor, in nervis cardiacis vel hepaticis; nam obſervatum eſt a medicis, quod cor in febribus ſummis inflammetur, &, quod œger moriatur, & tamen inde nullus fit dolor: ſentitur quidem *anxietas*, fidelis ille periculi nuncius, omni molimine agens, ut non fiat mors; *ſed non dolor*. Quando pulmo exeditur, vel hepar, vel ren conſumitur, nullus etiam dolor; ſed quando membranæ horum viſcerum ab inflammatione afficiuntur, ſtatim fit dolor immanis, *Ergo omnes partes nervoſæ non ſentiunt*, tamen hic nervi ſunt; ſed nervi qui a pare octavo, ab intercoſtali, a recurrente, a medulla ſpinali ad cor tendunt; in toto itinere quidem ſentiunt, *non vero in corde*; nam omnis muſculus delaſſatus ſentitur, ſed cor, quod ſemper agit, nunquam delaſſatur, nunquam dolet.

Boerhaave was well acquainted with the inſenſibility of the heart and other viſcera ſupplied by the great ſympathetic nerves; but did not know that the Ganglia on thoſe nerves occaſioned that inſenſibility.

In two memorable caſes recorded in 14 vol. Rat. Medendi of *De Haen*: both patients had the difficult reſpiration, and thoſe pleuritic pains which generally attend the peripneumony; yet in the diſſection of the firſt patient, the lungs were found inflamed and purulent, the *pleura* very much inflamed, the *pericardium* inflamed and thickened, the *heart* covered with that pellicle which is uſually found on inflamed parts, the ſubſtance of the heart *enormouſly inflamed*, *purulent water* in the cavity of the *cheſt* and *pericardium*.

In the ſecond caſe, all theſe parts were *inflamed*, the lungs, *pleura*, and *pericardium*; the ſubſtance of the *heart* itſelf was pale, and had no appearance of inflammation, though covered with a pellicle, which probably aroſe from inflammation of the *pericardium*.

In theſe caſes it was evident an inflammation of the heart furniſhed no pathognomonic ſymptoms: Dr. *Cullen* therefore very juſtly ſays, carditis gives no ſymptoms different from thoſe of peripneumony, with which it appears often to be complicated.

The celebrated *Carolus Piſo*, *Charles le Pois*, who wrote an excellent treatiſe on the diſeaſes of the nerves, though its title be, de Colluvie Seroſa. In his Sect. 3. C. 2. treating of palpitation of the heart —— Obſerved in diſſection, the cauſe of palpitation and difficult breathing was occaſioned by the pericardium being diſtended and filled with ſeveral pints of water. Nor is it to be wondered, ſays he, that the pericardium ſhould "*ſenſim & ſine ſenſu*," be gradually ſo much diſtended in that patient, as he before obſerved in another, *Elizabeth Bordes*, "Membranam Renis in eam amplificatam longitudinem quæ univerſam abdominis capacitatem, ſervata tamen figura exacte, coæquaret, et quatuordecem libras puris, exeſo, ſcilicet parenchymate & ſuppurato, contineret, nec ab eo pondere per aliquot annos continuitatem amiſſeſſet. *C. Piſo*, De morbis a Colluvie Seroſa.

If we except ſome few inſtances of diſeaſes attended with acute pain in the ſtomach, in the ureters, and gall ducts, from *Calculi*; inflammatory diſeaſes in which the pleura, and external membrane of the liver are affected; we can very ſeldom determine from pain alone, the preciſe part, affected principally in internal diſeaſes: and notwithſtanding the excellent rules in *Galen*, de locis effectis, and the aſſiſtance of a more accurate anatomy and an advanced phyſiology, we are obliged to infer it, from a nice, and frequently very precarious, induction.

Diſeaſes in the meſentery, pancreas, ſpleen, kidneys, and parenchyma of the liver, very frequently elude the diſcernment of the ableſt practitioners in medicine, and are only diſcovered after death by diſſection.

To the Ganglions ſeated, on theſe and other parts, having nerves ſupplied with them, it muſt be owing, that ſenſation does not conduct us with the moſt pointed preciſion to the parts affected by painful irritation: and direct to the immediate ſeat of an internal diſeaſe, as exactly and pointedly as we feel the ſeat of an external wound, or inflammation: or, as we feel a fit of the gout, of the tooth-ache, a pain at the ſtomach, a pleuriſy, or a quinſey.

We ought, without ſome eſſential difference in the nerves, which convey ſenſations, to feel the point of a needle in the gut, as ſurely as we feel it, when it pricks the finger; but the following obſervations inform us differently.

In May, 1773, I attended a perſon who had given himſelf a wound in the abdomen, from which a part of the inteſtinum ileum, which was opened, hung out of the body. At a time when the wound was recent, the gut not mortified, and the patient very ſenſible, he felt nothing; and was inſenſible of the needle being paſſed through the gut in ſtitching it up: nor did he feel the leaſt ſmart ſome days after, when the ſame wounded inteſtine, was touched with ſpirit of wine, or know, when I touched a ſound part of the gut with my finger; though he was very ſenſible when I touched any part of his ſkin.

In September, 1786, I had an opportunity, in our Infirmary, of repeating this obſervation, on one *Hughes*, who had one of the inteſtines laid bare by an ulcer, which penetrated through the integuments of the abdomen, and made a ſmall opening in one of the inteſtines. She did not feel, when a finger or probe touched the inteſtine, nor any ſmart when tinct. myrrh was applied to it; but when the integuments were touched with it, the ſmarting was quickly and decidedly perceived. A proof that ordinary ſenſation, is as much wanting in theſe parts, where moſt painful diſeaſes are nevertheleſs often ſeated, as we have before ſhewn it to be wanting in the heart.

But this point, ſo important in the diagnoſtic of internal diſeaſes, ſeems ſufficiently aſcertained, without additional proof, to call the attention of practical phyſicians to it in future.

In ſleep, and in apoplexies, the external ſenſes ceaſe to convey impreſſions to the ſoul; and the exerciſe of voluntary motion is ſuperſeded; but the vital functions have in theſe circumſtances the ſame, and ſome have believed, a greater ſtrength and vigour than before: the truth ſeems to be, that what is wanting in the frequency and number of reſpirations and of pulſes, is made up by their greater deepneſs and fulneſs. In ſleep, this temporary interruption of ſenſation and voluntary motion, ariſes from the nervous power being exhauſted, which by a few hours reſt is conſtantly recruited; and with it, a ſtate of vigilancy returns, in which the whole animal machine, its ſenſes, voluntary, as well as involuntary motions, are in complete action.

Apoplexies ariſe from ſome extravaſated fluid, or other cauſe, compreſſing the brain in ſuch a degree, as to put an end to its functions, (if not removed,) and thoſe of external ſenſation and voluntary motion, depending upon them.

It has been a queſtion long agitated, why in apoplexies, the ſame compreſſion does not intercept the nervous power, by which the *vital* functions, and *animal* functions are both ſupported: and how it happens, the heart continues to move, and the reſpiratory organs to act, for a conſiderable time after ſenſe and motion in the other parts ſeem to be at an end.

Some eminent phyſicians have attempted to ſolve this queſtion, by confining the cauſe of apoplexies to the brain only, from whence they ſuppoſed all the ſenſory nerves, and thoſe ſubſervient to voluntary motion, were derived: and that the cerebellum remained uncompreſſed, becauſe of the ſtrong and tenſe membranes, which are interpoſed betwixt it and the brain; and, that the vital organs from thence were ſolely ſupplied with nerves: (which is far from being true:) and this they imagined, proved by ſome experiments, in which wounds of the cerebellum, were found to occaſion immediate death in various animals.

But it being obſerved by others, that the worſt wounds of the cerebellum had ſometimes healed, and that not much difference, as to danger, could be obſerved, betwixt deep wounds of the cerebrum and cerebellum: and that fœtus's at their full time have been born alive, though deſtitute both of brain and cerebellum: and lately it having been found that the ſpinal marrow may be cut through near its origin, and the eighth pair, and great ſympathetic nerves divided, by which all communication both with the brain and cerebellum is cut off, yet, to the aſtoniſhment of beholders, the heart continuing to move for many hours afterwards, this theory falls of courſe; and we are obliged to ſearch out ſome other cauſe, which may account for this phænomenon, in a more ſatisfactory manner.

I am not without hopes, that the doctrine we have advanced concerning the nature and uſes of Ganglions of the great ſympathetic nerves, will afford a natural ſolution of this difficult problem. The great ſympathetic nerves being truly derived from the ſpinal marrow, have in the numerous Ganglions proper to them, ſo many receptacles of nervous energy, ſo many ſubordinate brains, which continue to diſpenſe the nervous energy to the vital organs, long after they ceaſe to have communication with the brain; and ſupport the *irritability* of the heart, *which* makes it ſo long ſenſible to the ſtimulus of the blood flowing into its auricles and ventricles, after the reſt of the machine is in fact dead: but, as the whole nervous ſyſtem derives its energy from, and ultimately depends upon, the brain and cerebellum, theſe ſubordinate ſources of nervous energy, being at length exhauſted, without a poſſibility of a new afflux from the brain, the vital organs at length ceaſe to move.

This reaſoning ſeems ſtrongly confirmed by thoſe fœtus's already mentioned, which come into the world without any brain or cerebellum: theſe generally have the medulla ſpinalis large enough to ſupply the great ſympathetic nerves: and by theſe nerves, the force of the heart, the circulation, and developement of the organs of the fœtus, are ſuſtained in the mother's womb; for ſuch fœtus die, as ſoon as they loſe the mother's foſtering heat, if not dead before their birth.

By the inter-communion of nervous energy ariſing from the numbers of Ganglions on the great ſympathetic nerves, we underſtand alſo how, and by what means, the vital and involuntary powers of our machine, go on unimpaired in perfect hemiplegias, which reduce one half of the animal body to a ſtate of mere vegetative life, the muſcles of one ſide being no longer obedient to the will: when this is thoroughly conſidered, it will be found a ſtrong proof of our doctrine: for if the filaments of the nerves were not interrupted by, and intermixed in, Ganglions, in their courſe from the brain to the viſcera, but were continued threads or ſubſtance, as they are from the brain to the ſenſory organs, and voluntary muſcles, a very manifeſt defect muſt have appeared in the functions of the viſcera contained in the thorax and abdomen, by the loſs of half the nervous power diſtributed to them: that is, a greater defect muſt have happened in every hemiplegia, than ever happens in any one.

It ſeems conſiſtent with this view of Ganglions, as ſubordinate origins of nerves ſent to the inteſtines, yet, ultimately derived from the brain; rendering ſenſations leſs determinate, yet, not precluding them in an indiſtinct way from reaching the ſenſorium commune: it is, I ſay, natural to expect from, and conſiſtent with this doctrine, that ſuch cauſes as very conſiderably compreſs the whole brain, or ſpinal marrow near the head, ſo as to intercept external ſenſation, will alſo blunt very conſiderably the ſenſation, and leſſen the irritability, of the parts to which the intercoſtal nerves are diſtributed: this indeed actually happens in dangerous attacks of the apoplexy, in which the moſt irritating medicines, the moſt violent and ſtimulating cathartics, in doſes, which at other times would be poiſonous, are often inert and ineffectual, from the unfeeling ſtate of the inteſtines: this alſo happens when the ſpinal marrow near the head is greatly compreſſed, of which we have a curious inſtance in the laſt volume of London medical obſervations.* But in other caſes, where I have known the ſpinal marrow compreſſed, though leſs conſiderably, and at a greater diſtance from the brain, this effect has not followed: when that total compreſſion is but a little removed, and the nerves of one ſide only, as in the hemiplegia, or perhaps ſtill fewer than half the nerves, paſs down the ſpine free from preſſure, then the inteſtines *altogether* recover their ſenſibility, and the heart continues to act with its wonted vigour; by which we know, that by ſome communication of the nerves in Ganglions, analogous perhaps to an anaſtomoſis, the functions of the viſcera are carried on ſufficiently.

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* See Medical Obſervations by a Society in London, Vol. iii. Art. xviii. p. 160. and *M. Du Verney*'s obſervation in Reg. Scient. Acad. Hiſt. Lib. iii. *Du Hamel*, p. 264. We have alſo curious inſtances of the ſame kind

I might go on, to confirm the reality of ſuch a communication of nerves in Ganglions, as is above ſuggeſted, by various phænomena in other diſeaſes, which plainly point it out; and to account for the production

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kind in the very uſeful and intereſting inquiry into the efficacy of warm bathing in palſies, by the ingenious Dr. *Charlton.*—*John Waterman*, aged thirty-four, by a fall, had the third and fourth vertebræ of his neck diſtorted. The paralytic effects of this diſtortion, which remained when he was admitted into the Bath hoſpital, and which were ſoon removed by pumping upon the neck, (the vertebræ gradually ſliding back into their natural ſituation,) were, a palſy in his lower limbs, and a monſtrous diſtenſion of his belly, which was ſore to the touch, and if ſtruck on, ſounded like a drum; he was coſtive, and it was with the utmoſt difficulty he parted with his urine. The ſwelling of the belly ſubſided by great diſcharges of wind from the ſtomach, and in proportion to its decreaſe, the action of the bladder and the periſtaltic motion of the bowels were reſtored, with the perfect uſe and feeling of his limbs, p. 58. See alſo Mrs. *Whitby*'s caſe, ibid, p. 31. See alſo note in Section third of this Eſſay.

production of ſympathy, in many caſes, in conſequence of that connexion. I might alſo ſhow, that Ganglions probably have ſome uſe in ſecretion, by ſecuring a more uniform motion of the liquors in the ſecreting organs: as it is certain that the viſceral glands, and even the teſtes, are univerſally ſupplied with nerves from the great ſympathetic ſtock, and that the ſalivary glands have nerves from the ſmall branches of the fifth pair of nerves, on which Ganglia have been found by *Mekelius* and *Haller*. (See Sect. 111.) It is highly probable that Ganglions have ſome important uſe in ſecretion. That by giving a check to the ordinary powers of the mind, the energy of the nervous influence is appropriated wholly to the operation of ſecretion, and a more uniform motion of the liquors ſecured in the ſecreting organs. This is the more likely, as it is well known, that the ſecretions are much affected and diſturbed by paſſion, or any extraordinary movement of the mind.

I do not attempt to explain the myſtery of ſecretion; but it has been, I think, well obſerved, that the whole inteſtinal canal, is really a gland, that the lacteals are its ducts, which carry off the ſecreted and digeſted liquors: that all other glands are analogous to it.—Indeed the functions of this tube, and the power of digeſtion, have an analogy ſo obvious to glandular ſecretion in general, that much light is thereby thrown upon it; when it is conſidered that all the glandular internal viſcera derive nerves from Ganglia, and, that the inteſtinal tube is ſo furniſhed; that the periſtaltic, and involuntary motions of the inteſtinal tube, are excited by the unperceived ſtimuli of the bile, and other digeſtive liquors, as well as of ingeſta and air. In like manner the ſecreting organs are actuated by the ſtimulus of their contained liquors alone. Theſe liquors or fluids, ſeem ſeparated in each gland, for the purpoſe of preparing the ſpecific fluid to be ſecreted therein, in a manner ſimilar to the gaſtric liquor, which is prepared in the ſtomach and inteſtines for the purpoſe of digeſtion. If the ſtomach has by this means, its proper aſſimilating digeſting power, which in ſome circumſtances devours and digeſts its own ſubſtance, why may not each gland, likewiſe poſſeſs its ſpecific aſſimilating power, its digeſting fluid, by which it produces its peculiar ſecreted liquor, and no other? —— But I leave the proſecution of this hint to others, as ſuch diſcuſſions as theſe would lead me into a very wide and uncertain field of phyſiological diſputation: it would be more my inclination, by purſuing the ſame clue of obvious facts and experiments, to try to make ſome advances in the knowledge of nervous diſeaſes, which being ſo near the ſeat of the mind itſelf, afflict it more ſenſibly than thoſe which affect the nerves leſs, and are thereby more remote from the mind: changeable beſides, and intricate in themſelves, they ſeem to have been rendered more ſo, by the wild and hypothetical manner in which they have been for the moſt part conſidered. The moſt precious truths, even on that ſubject, may be more within our reach than we are aware of, provided we adhere cloſe to the method of obſervation in our reſearches, and carefully diveſt ourſelves of prejudices ariſing from received theories, which, involving the mind as in a miſt, render it leſs apt to perceive and admit the truth: but I leave this exquiſite taſk to thoſe who have abilities proportioned to its importance; to the *Hallers* and *Tiſſots* of this, and the *Boerhaaves* and *Whytts* of ſucceeding ages.*

——— Nec meus audet
Rem tentare pudor, quam vires ferre recuſent.

I ſhall therefore now finiſh this Eſſay with a recapitulation of the principal matters endeavoured to be proved in it; and with reflections not unſuitable to my ſubject.

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* Dr. *Tiſſot* has already publiſhed a conſiderable part of a very important work on the diſeaſes of the nerves; and the medical world expects with impatience the remainder of a deſign, which does equal credit to the comprehenſive learning and ability of the ingenious author.

SECT. VII.

Now heav'n in all her glory ſhone, and roll'd
Her motions, as the great firſt Mover's hand
Firſt wheel'd their courſe; earth in her rich attire
Conſummate lovely ſmil'd; air, water, earth,
By fowl, fiſh, beaſt, was flown, was ſwum, was walk'd
Frequent; and of the ſixth day yet remain'd;
There wanted yet the maſter work, the end
Of all yet done; a creature who not prone
And brute as other creatures, but endu'd
With ſanctity of reaſon, might erect
His ſtature, and upright with front ſerene
Govern the reſt, ſelf-knowing, and from thence
Magnanimous to correſpond with heaven,
But grateful to acknowledge whence his good
Deſcends, thither with heart and voice and eyes
Directed in devotion, to adore
And worſhip God ſupreme, who made him chief
Of all his works.

PAR. LOST, B. vii.

Recapitulation.—Final cauſe of our vital motions being involuntary.

THE Ganglions, reſpecting their ſtructure, may juſtly be conſidered as little brains, or germes, of the nerves detached from them, conſiſting of a mixture of cortical and nervous medullary ſubſtance, nouriſhed by ſeveral ſmall blood veſſels, in which various nervous filaments are collected, and in them loſe their rectilinear parallel direction, ſo that a new nervous organization probably takes place in them.

Reſpecting their uſes, Ganglions ſeem the ſources, or immediate origins of the nerves, ſent to organs moved involuntarily; and probably, the check or cauſe, which hinders our volitions from extending to them.

Ganglions ſeem analogous to the brain in their office: ſubordinate ſprings, and reſervoirs of nervous power, they ſeem capable of diſpenſing it, long after all communication with the brain is cut off. And though they ultimately depend upon the brain for its emanations, it appears from facts, that, *that* dependance is far from being immediate and inſtantaneous.

From the Ganglions ſerving as ſubordinate brains, it is, that the vital organs derive their nervous power, and continue to move during ſleep: and, to the ſame cauſe, as well as to its greater irritability, we may refer the continuance of the motion of the heart, ſo much longer than that of the voluntary muſcles, in perfect apoplexies.

From

From thence too, the motions of the heart receive for ſome time, ſupport, even after the ſpinal marrow and the intercoſtals, in their deſcent along the neck, are cut through: ſo that animals ſurvive this experiment ſometimes thirty hours, which however proves at length certainly fatal, by cutting off all communication with the prime fountain of nervous emanation.

In a word, *Ganglions* limit the exerciſe of the ſoul's authority in the animal œconomy, and put it out of our power, by a ſingle *volition*, to ſtop the motions of our heart; and in one capricious inſtant, irrevocably to end our lives.

However in the dark we may be, what ſubordinate agents are employed by an *Almighty arm*, to wind up and regulate this delicate machine, ſo uniformly to guide and direct, independant of us, our vital and involuntary motions, we muſt at leaſt clearly diſcern the goodneſs, and unerring wiſdom of our CREATOR, acting therein, though by ways paſt finding out, for our preſervation and ſecurity.

Being thus led up to this exalted truth, the natural and happy fruit of my ſubject, I hope to be excuſed expreſſing more at large (though ſtill in a very ſummary, and imperfect manner,) my ſenſe of it, and in giving a curſory glance, at the *final cauſe* of a contrivance by which we live.

Reſearches carried far into nature, conſtantly lead us to traces of an all-governing Deity, exerciſing a ſovereign authority over His works. The motions of the largeſt maſſes, and moſt minute particles of matter, all performed with the ſame order and eaſe, and regulated by laws ſurpriſingly ſimple and extenſive, penetrating the inmoſt receſſes of bodies, and extended throughout the *univerſe*, evince the direction of an omnipreſent Almighty Power, actuating the whole.

In every part and operation of nature, the fitneſs of things to one another, and *one deſign*, and their ſubſerviency to the beſt ends, and to the uſe and felicity of intelligent beings, point out the conſummate wiſdom and goodneſs of *One* great *Artificer*, *One* original *Mind*.

The *courſe of nature* is undoubtedly the effect of the inceſſant direction of the Deity, no leſs than its creation and original arrangement: it ſeems impoſſible, and incomprehenſible, that any mechanical power, any organization of mere matter, could of itſelf, without direction or art, produce vegetables and animals, all machines of exquiſite conſtruction, at all times and every where ariſing into being in amazing profuſion: taſting life, and by an eſtabliſhed order, made inſtinctive and blind inſtruments to beſtow it on others, and then retiring from this ſtage of exiſtence after a ſhort appearance upon it. But

> ——————"*The univerſal Cauſe*
> *Acts not by partial, but by general laws.*"

By ſuch laws originally eſtabliſhed to ſecure the uniformity of nature, the conſtancy of cauſe and effect, and the permanency of ſpecies, God directs the ſucceſſive *evolutions* of the animal and vegetable tribes. The verdure of the field, and all its flowery plants, the humble ſhrubs, and the lofty trees, in infinite variety, are his conſtant care, as well as his bounteous gift. Sole giver of life, He inſpirits with animation the meaneſt inſect, and moſt abject reptile, no leſs than the more perfect and nobler animals, and by His wiſdom guides them all to the ſeveral ends of their exiſtence.*

Every thing, in fine, on earth and in the heavens,

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* This is a truth deduced from the moſt profound examinations into nature, as well as apparent from a ſuperficial ſurvey of it, and agreeable to *common ſenſe.*

'Tis a truth proved and confirmed by the diſcoveries of a *Haller* and a *Bonnet*, as well as by the reſearches of the ableſt interpreters of nature in all former times. By thoſe of *Ariſtotle*, *Cicero*, *Galen*, *Bacon*, *Boyle*, *Newton*, *M'Laurin*, who concur in demonſtrating that the laſt *link* in the *chain* of natural cauſes terminates at the throne of GOD.

In vain have various perſons endeavoured to give a ſatisfactory account of vens, manifeſts and preſents him to us; and in the wonders of the loweſt, as well as the moſt magnificent of HIS works, the underſtanding with tranſport traces the perfections of a CREATOR, who is not far from every one of us, and in whom we live, move, and have our being; ſees his fingers touching the keys of nature, producing harmony in the univerſe; and his omnipotent arm unwearied for ſo many ages ſuſtaining, conducting every thing.

But we ourſelves are an abridgement of the univerſe, and, with reverence be it ſpoke, contain within us the image of its CREATOR; and were it poſſible not to trace HIM in that vaſt theatre where he

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of the origin of organized bodies, by any mere mechanical operation: as eaſily might we conceive a watch capable of producing its like without a maker. The efforts of a modern writer of great genius, in favour of this cauſe, have not given more ſatisfaction than thoſe of *Democrates* and *Des Cartes* formerly gave. Happy in overturning the *falſe* ſyſtem of generation founded on the obſervations of *Leewenhoeck*, he has built upon its ruins one, no leſs imaginary, and in all reſpects more exceptionable.

The microſcope, indeed, diſcovers to us, not only in the *ſeminal liquors* of animals of *both ſexes*, but alſo in infuſions of all kinds of animal and vegetable matter, *animalcules* ſmall and various beyond all conception, but ſtill poſſeſſing every characteriſtic of a living and complete animal.

Though theſe animalcules are over-rated in the *Leewenhoeckian* ſyſtem of generation, they are under-valued in that of *De Buffon*, and have, like ignes fatui, led both into miſtakes.

To call theſe microſcopic animals, particles of mere *unorganized matter*, *ſelf-*

He exerciſes His power and wiſdom with ſuch magnificence, we might nevertheleſs contemplate His Being and Attributes diſplayed in our ſtructure, and exerciſed in our preſervation.

The mechaniſm of our body, the connexion and ſubſerviency of all its parts to a common purpoſe, the exquiſite contrivance of its organs, conſiſting of all the various orders of veſſels, interwoven with wonderful art, have led anatomiſts in all ages to acknowledge an infinitely wiſe and powerful Maker. Among the moſt precious remains of antiquity, are thoſe commentaries of *Galen*, wrote on the uſes of the parts of the human body, as hymns and offerings of praiſe to our great Creator.

ſelf-moved, and ſelf-active — organic particles, unorganized, but tending into organization, & une matiiere vivante, is a prodigious petitio principii, and abuſe of language.

But ſtill, in order to evade the acknowledgement of art in the formation of animals, it is ſaid, theſe organic particles are determined to this or that ſhape, are organized, by means of animal *moulds*: this is ſtill aſſuming what is deſtitute of proof, and ſaying what cannot be conceived or underſtood, if any thing elſe is thereby meant beſides the aſſimilating power of a body already formed. In any other ſenſe, moulds capable of forming machines ſo complete, ſo aſtoniſhing, of imparting form, external and internal, order, connexion, motion, life, with ſuch amazing exactneſs and propriety, in machines conſiſting of ſuch a prodigious variety of parts, would be more wonderful than the machines themſelves: they explain nothing, and inſtead of ſhowing how animals may be made without art, they ſuppoſe a higher exertion of it; but an exertion paſſing all comprehenſion: and this celebrated *modern* ſyſtem, with all the embelliſhments

TOR. Is it, indeed, otherwiſe conceivable how ſuch conſiſtency and harmony could have taken place in the different parts of our wonderful frame? How they could have been ſo exactly fitted to each other, and to the exterior objects, which have an evident relation to them, and the ſyſtem they compoſe? Could the bones and muſcles have been ſo well diſpoſed for motion, without a ſuperior knowledge in mechanics? The eye ſo admirably adapted to admit light and appropriated to viſion, was it formed without a knowledge of optics? Or the ear, without the ſcience of ſounds? To attribute contrivances like theſe, and even underſtanding itſelf, to unintelligent cauſes, rather than to the all-wiſe Parent of nature, ſeems an incomprehenſible perverſion of reaſon and philoſophy.

From

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bellifhments of eloquence, and ornaments of language, has not the credibility even of a romance.

The *vital* and eſſential parts of animals could not have ſubſiſted *ſeparately*, or been produced one after another, but muſt have been one coæval ſyſtem, formed at once, and connected together previous to what is called *generation*, which is, in fact, only the occaſion of the growth and increaſe of theſe rudiments of a nervous and vaſcular ſyſtem in bulk and ſtrength, and into ſuch parts, as are capable of ſhooting and vegetating from them.

If it be admitted as eſſential to animal life, that the heart ſhould receive its nervous influence from the brain, and the brain its nouriſhing blood, and the liquor it is to ſeparate for the uſe of the nerves and the purpoſes of muſcular motion and ſenſation, from the arteries; and, that a part

From the curious ſtructure of our bodies, we infer the wiſdom and power of our Maker; but in the conſtitution and operation of our rational ſoul's, man's nobleſt part, and true eſſence, the image of God is impreſſed and delineated, and His government of the univerſe exemplified; more eſpecially in the conſcious exercise of that power, by which we, as free agents, are capable of exciting an infinite variety of movements in our bodies, all of them depending upon, and regulated by our volitions; while others go on with a ſeeming ſpontaneity and independance, and begin and end only with life itſelf.

Even our inclinations and paſſions, thoſe ſources of ſo much apparent ill, are, by the Deity, providentially rendered the means of our preſervation both

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part of theſe fluids ſhould again return to the heart by the veins; it is eaſy to perceive that in the generation of animals, a heart and a brain, and their communicating veſſels, and mutual dependencies, could never be produced at all, much leſs produced at once, by the circulation of the different liquors of the parent animal in their proper veſſels, or by any alteration theſe liquors undergo in the *organs of ſecretion or of generation*: and that the production of an animal, is a work not to be effected by matter and motion alone, and is ſuperior to all mere mechanical means.

Good obſervations and juſt reaſonings lead us to conclude, that all plants and all animals whatſoever, in their ſeminal ſtate, are pre-formed, and that their eſſential parts exiſt in miniature; but in a dormant and inactive ſtate, very different from that of *microſcopic animalcules*, or moving particles ſeen by the aid of *microſcopes*.

Fecundation

as individuals and as a race: and an inſtinctive affection for theſe ends and thoſe means, powerfully operate upon us, and like two different powers acting in one direction, conduct us with redoubled force to the ends intended by our Maker to be produced by them. Theſe important ends are always leſs ſecured by our inſtinctive love of life, fear of death, and natural deſire of progeny, than by the more vehement appetites and inſtincts, which allure us to the exerciſe of certain faculties more immediately as gratifications, than as the efficient means, which by experience are known to fulfil the

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Fecundation puts this germinating principle, this *bud of being*, peculiar to every ſpecies, into life and action. The male ſperm ſtimulates the little heart, and rouſes it into motion, and gives occaſion to a circulation of liquors in organs prepared for it, but till then at reſt; it is thus the means of nouriſhing, enlarging, and unfolding what already exiſted, what was already formed and created, but creates nothing. Creation is the work of God alone. He is *our* true Father, and all plants and animals which are, have been, or ſhall be upon the earth, are indeed the immediate productions of His hand.

If it be found impoſſible to account for the re-production of animals by equivocal generation, or by any mere mechanical operation; and, in order to obtain ſome tolerable comprehenſion of this great myſterious work, we muſt have recourſe to ſuperintending intelligence, and refer the generation, as well as formation of animals, to the art and power of God: I ſee no reaſon why, to the excluſion of the ſame active principle, we ſhould very anxiouſly ſeek to refer the involuntary and vital motions of animals, to mechanical cauſes alone, or to any other than to their original Mover; eſpecially when we conſider that theſe motions ſeem deſignedly with-held from the volitions of our own minds, and that, unconſcious of them, we neither deliberate concerning them, nor ever find them obedient to the authority of our will.

the purpoſes of nature: and theſe inſtincts have in common with every ſpring of action infixed in our frame, a ſtrength and impetuoſity capable of carrying us too far, the more certainly to ſecure their efficacy as incitements to the great ends of animal life.

Yet, the love of life and all its enjoyments, and the fear of death and all its dreaded harbingers, would have been but inſufficient ſecurities for our carrying on the vital motions, with that conſtancy and uniformity neceſſary to the preſervation of life, if theſe motions had depended on our will and choice. Reaſon would have deliberated concerning them with too much ſlowneſs, and volition would have executed them with a dangerous and fatal caprice. For, if the heart had been ſubjected to the ſoul's authority as much as the voluntary

muſcles

The many unſucceſsful attempts of ingenious phyſicians to account for theſe motions on the principles of mere mechaniſm, ſhould convince us of the vanity of ſuch attempts, and that they labour under ſome inſuperable difficulty. Nor can the doctrine of *Stahl*, who refers all theſe motions to our ſoul, be admitted, till the adherents of his ſect inform us, when the ſoul firſt began to be cloathed with body, and aſſumed the direction of its œconomy, and operations, of which, after all our reſearches, we remain ſo ignorant; when it firſt ventured to let the heart pant, and imparted motion to the vital parts; and when it exerciſed the power of ſuſpending and renewing theſe motions: till, I ſay, we are better ſatisfied in all theſe particulars, it will be moſt rational, as well as decent, to refer the carrying on, and direction of, the vital and involuntary motions of animals, with their formation, to the DEITY, by whom, indeed, we are fearfully and wonderfully made and preſerved.

muſcles are, if its motions could have been ſuſpended, or ſtopt with the ſame facility, death would then have coſt us no painful pang: and, whenever the body was tortured by pain and diſeaſe, or the mind in anguiſh from grief or diſappointment, a remedy ſo eaſy to be applied, (an eſcape from all *preſent* miſery, made by the very act, and in the inſtant, of choice,) would have been recurred to with a dreadful frequency. Death, no longer armed with pain and terror, would in a ſhort time have extirpated the human race.

The preſervation therefore, and ſecurity of life in every moment of it, depends upon our vital motions being entirely ſuject to the wiſe government of the Author of our lives; who charges HIMSELF with the immediate care of them, and of us.

All this, when attentively conſidered, muſt affect us with a ſenſe of GOD's goodneſs; *who*, tenderly reſpecting the imbecility of man's nature, hath been pleaſed by appetites and paſſions, to excite him to acts of ſelf-preſervation; and where the violence of theſe might have been hurtful, no leſs than the ſlowneſs and inſtability of reaſon, hath taken our ſafety under his own more immediate direction.

That mind muſt be ſtrangely prepoſſeſſed and bewildered with falſe ſcience, which rather ſeeks for the cauſe of theſe involuntary motions in dead matter, organization, chance, neceſſity, ſomething that without knowledge or power, acts wiſely and powerfully, than in the great fountain of *Power*, *Wiſdom*, and *Animation*.

Unleſs to ſuch, this field of ſtudy, (to uſe the words of an elegant writer,*) " cannot be barren " of praiſe to our CREATOR, nor unproductive to " ourſelves of that noble and uncommon union of " ſcience and admiration, which a contemplation " of the works of infinite wiſdom alone can afford " to a rational mind; whilſt referring to HIM " whatever we find of right, or good, or fair in " ourſelves, diſcovering his ſtrength in our weakneſs and imperfection, honouring them where " we clearly diſcover them, and adoring their profundity where we are loſt in our ſearch, we may " be inquiſitive without impertinence, and elevated without pride; we may be admitted (if I " may dare to ſay ſo) into the counſels of the Almighty, by a conſideration of HIS WORKS."

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* Eſſay on the Sublime and Beautiful.

II.

CUI BONO?

OR,

HYSIOLOGICAL AND PATHOLOGICAL OBSERVATIONS

ON THE FUNCTIONS OF THE

VISCERAL NERVES.

WITH SOME

REMARKS

ON THE ACTION OF

OPIUM,

AND OTHER

VEGETABLE POISONS.

INTRODUCTION.

A LONG ſeries of years is often required for the admiſſion of new truths. The period cannot be limited to thirty or forty years.

It depends on circumſtances peculiar to the age, the ſubject, and the author's ſituation; and mine certainly has no peculiar advantages.

'Twas thought audacity in *M. Fagon*, to defend the *Harveian* diſcovery, near forty years after the firſt promulgation of it in England.

Before truth in its ſilent, or diſputed march, has rouſed the attention of the indolent, converted the ſupercilious, ſubdued the intereſted and obſtinate, and reached the ears of all, an age has paſſed away.

It is thirty years ſince my early thoughts on the uſes of the Ganglions of the nerves, were communicated to my correſpondents Dr. *Whytt*, and Baron *Haller*, and in the Phil. Tranſactions in 1764, and ſeq. and more than twenty years ſince, on maturer reflection, my Eſſay on that ſubject[*] was publiſhed as a ſeparate work.

My opinion has been ſilently attacked, and as ſilently adopted, without any explicit acknowledgement of the author, or, any direct quotation from his work. Several of the objections, which I have anſwered, were communicated in a correſpondence with which I was honoured by Baron *Haller*, afterwards publiſhed in the ſupplement of the Encyclopedia: and I have reaſon to think, from a letter afterwards received, my anſwers were ſatiſfactory.

My work was favourably received by Dr. *M'Kittrick*;[†] and not only received candidly, but ingeniouſly analyzed, by the celebrated Dr. *Tiſſot*, in his excellent Traite des Maladies Nerveuſes [*]

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[*] Salop, 1771.

[†] See Commentaries on the Principles and Practiſe of Phyſic, large octavo.

Frederic Caſimir, ſeems to have adopted my whole ſyſtem, in a work publiſhed at Manheim, 1774, of which *Haller* gives an account in his hiſtory of Anatomy, 2 Tom. 666. [†] My Eſſay moreover has been elegantly tranſlated into the German language, by Dr. *Kolpin*, a learned phyſician at Stettin. [‡]

I ſay nothing of the private, and perhaps partial, teſtimonies of my correſpondents.

Whether my ideas have been the occaſion of the attention which, ſince the firſt publication of them, has been given by anatomiſts to the great ſympathetic nerves, and the ganglions, I ſhall not deter-

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[*] Traite des Nerfs & de leurs Maladies, T. 1.—p. 2.—page 120.

[†] Von der leben craft. "Voluntatem nihil in organa Vitalia poſſe, quæ ſuo officio defungi ſit neceſſe, cum tamen ganglia vim a voluntate ſubmiſſam frangant. vid. *Haller*. Hiſt. Anat. 2 vol. p. 666.—See alſo p. 596, ib. for his account of my Eſſay on the Ganglions.

[‡] Verſuch uber den Nuſſen der Nervenknotten von *James Johnſtone*, &c. Stettin, 1787. 8vo.

mine. But, having attended to the learned and ſplendid works of *Neubaver*,[*] *H. A. Wriſberg*, of Gottingen,[†] Dr. *Alexander Monro*, at this time profeſſor of anatomy in Edinburgh,[‡] and *Walther*, of Berlin,[||] I find nothing in them which does not confirm, the uſes I have aſcribed to the ganglions of the nerves. However much they differ from former anatomiſts, however much they have improved the anatomy of the great ſympathetic nerves, they add to, and confirm the evidence, before known, that the cardiac nerves, and ſplanchnic nerves, proceed uniformly and conſtantly, from under ganglions, of the great ſympathetic nerves.

I proceed to ſuggeſt ſome pathological illuſtrations and conſequences of this apparatus, ſo invariably appropriated to the organs of involuntary motion.

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[*] *Johannis Erneſti Neubaver*, M. D. prof. Jenenſis Deſcriptio nervorum cardiacorum, &, de nervo intercoſtali dextri lateris cum Iconibus. 4to.—1772.

[†] *Henrici Auguſti Wriſberg*, prof. anatom. Gotting. In Comment, Gottingen. 7 Tom. De quinta Pari nervor.—Et poſtea de nervo ſympathetico Maximo, ibid. 1780.

[‡] Obſervations on the Structure and Functions of the Nervous Syſtem, by *Alexander Monro*, M. D. profeſſor of anatomy, Edinburgh, fol. 1783.

[||] *J. C. Walther*, Tabulæ Nervorum Thoracis, et, Abdominis. folio maximo Berolin, 1783.—Very elegant figures.——Other works may have been publiſhed abroad, which have not come to my hands or knowledge.

In the next age, conſequences of theſe truths, will be unveiled, to an extent not now to be conceived, but of the greateſt importance in the healing art: in the mean time, what is here propoſed, will furniſh ſome direction to a ſagacious ſearcher into the ſeat and nature of internal diſeaſes.

OBSERVATIONS, &c.

FIRST PART.

Internal organs inſenſible to a degree; as well as involuntary—Influence of paſſions extends to them, and to the glands—Palſy, and diſeaſes of the head and heart—Caſes—and, of the iris.

1. THAT the brain is the principal vital organ in animals, the center of ſenſation, and the ſource of the energy and motions, of which they are capable, has been long known.

2. That the energy of the brain, is diffuſed over animated bodies by the nerves, and is occaſionally excited in ſenſation and voluntary motion, has alſo been known ſince the days of *Eraſiſtratus*, that is, for two thouſand years.

3. That nervous energy is neceſſary to the involuntary motions of animals, has alſo, with ſome exceptions, been generally acknowledged. Many ingenious attempts had been made, to explain *how* theſe involuntary motions proceed ſpontaneouſly in

animals, without the excitement of volition: but none of them with ſucceſs, till *Senac*, Baron *Haller*, and *Whytt* diſcovered, irritability to be univerſally the acting ſpring in them.

4. But to ſupport that irritability, and theſe vital powers permanently, the energy of the brain and nerves being found neceſſary, it remained to be explained, by what check, by what mechaniſm, the powers of volition were prevented from occaſional and *active interference* in the involuntary motions. The uſes proved in my former Eſſay, to belong to the ganglions of the viſceral nerves, have removed this *important* difficulty.

5. Theſe proofs demonſtrate that the ganglions of the nerves, are obſtacles and limits to the powers of volition in the nervous ſyſtem, univerſally: the checks by which its empire is bounded, and its caprices guarded againſt, by our all-wiſe Creator, who, ever watchful for our preſervation, gives us powers which are uſeful and ſalutary, and takes from us thoſe, which would have been pernicious in the animal frame and œconomy.

No nerve goes to the heart, or to any of the abdominal viſcera, but through the medium of a ſucceſſion of ganglions.*

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* See *Wriſberg* de Nervo intercoſtali.

Nerves diſtributed to the muſcles ſubject to volition, and to ſenſory organs, do not paſs through the medium of ganglions.

When the nerves going to voluntary muſcles are tied or cut through, ſuch muſcles are no longer voluntary; — but involuntary motions may be excited in them, below the ligature and inciſion. — In like manner, the proper functions of the glands, and the vital and involuntary organs, may be finally deſtroyed, by diviſions and ligatures of the great ſympathetic nerves, the only ones which are acceſſible, and on which anatomiſts can make ſuch experiments.

I farther add, that ſtimuli acting above ganglions, neither act upon, nor occaſion any contraction of, and in the heart and inteſtines; but acting below the ganglions, upon theſe organs, they conſtantly have that effect. The induction is complete and demonſtrative.

6. Here let me not omit to obſerve, that the moſt accurate and diligent anatomiſts, find an evident and conſtant difference in the ſtructure of the plexus, and ganglions. — In the plexus, the nervous filaments and medullary ſubſtance, may be traced, *unmixed*, to and from the nerves which contribute to the plexus, and which are aſſociated

and united in them. Thus *Wriſberg*: " Nervorum anaſtomoſi, quaſi vaſorum inſtar, in unum filum confluerant, quæ non-nullis placet, vix aſſentiri poſſum: cum in pleriſque nervis ramorum diviſio, perſciſſa intermedia celluloſa, ad ortum nervi continuari queat." De nervo ſympathetico maximo. The ſame diligent anatomiſt has ſhewn, that in ganglions, the continuity of the nervous filaments is abſolutely loſt; or are therein ſo intangled and contorted, with cellular membrane and veſſels, as to be hard like a callus. Yet the ultimate organic ſtructure of a nerve is unknown, and ſo are its latent modifications, excepting thoſe I have deſcribed, whether in plexus or ganglia: their characteriſtic marks and differences, are nevertheleſs obvious, their uſes alſo are eſſentially different.—The aſſociations in plexus ſeem deſtined to preſerve *union* and *communication* betwixt the nerves in every part of the body, for the purpoſes of voluntary motion, and in a manner not very perfectly underſtood, to fortify the nerves for that purpoſe.

The ganglions, on the contrary, are organized for the purpoſe of ſeparating from the power of volition, all the organs, moved by ſtimuli, acting on irritable parts, in the vital and other involuntary organs.——The heart,—the inteſtines,—the abdominal viſcera, and glands in general,—the *Fallopian* tubes, and uterus—the iris.

Senſation, by the ſame means which intercept volition, is blunted in theſe organs, and irritability is encreaſed.

The hardneſs and calloſity of the ganglia is ſo great, and ſo widely different from the pulpy ſoftneſs of the medullary ſubſtance of the nerves and brain, that in whatever mode imagination or theory, may account for the action of the nerves, that of ganglions, muſt appear totally different.——Let us ſuppoſe, that ſenſation and voluntary motion are carried on by a ſubtle fluid, moving with all neceſſary celerity in the nervous tubes, — the intricate convolutions of nervous matter, evident in ganglions, muſt neceſſarily retard, or intercept, or vary, the motion and direction of that fluid.—Call it vibration, or undulatory motion, propagated ſomehow or other along the nerves, ſtill it would ſeem, that motion, muſt be impeded by theſe knots.

This doctrine, and the uſes aſcribed to ganglions reſting on the ſame firm evidence, and *proof ſimilar*, *and*, *as ſtrong*, as that by which nerves are known to be inſtruments of ſenſation and voluntary motion, I proceed to ſhew their extenſive influence in the animal ſyſtem, in various particular inſtances.

7. I ſhall not here repeat the facts which prove,

that the glandular viſcera are but very inconſiderably, and obtuſely, ſenſible. This has been occaſionally noticed by ſuch as have related particular facts and obſervations, and was not unknown to the ancients. But it is fully proved by Baron *Haller* and his followers, in their innumerable experiments on various animals, to determine the irritability, ſenſibility, and inſenſibility of different parts in animals. The dull ſenſibility, or inſenſibility, obſerved by them and others, was not owing to a want of nerves in the glandular viſcera, but to thoſe nerves deſcending into them from ganglia, which prevent quick ſenſation, as well as voluntary excitement from the mind. But, like as the heart, though it cannot be affected by volition, is nevertheleſs liable to be agitated by paſſion, of greater or leſs force: ſo ſtrong affections and emotions of the mind, influence the *ſecretions*: thus terror, and hypochondriac and hyſteric fits, occaſion a ſudden ſecretion and flow of limpid urine: luſt increaſes the ſecretion of ſemen; hunger, and a ſight of victuals, cauſe ſaliva to flow into the mouth: tears are forced by grief from the lacrymal glands, and bile from the gall ducts, agitated by violent paſſion.

The miſchief of violent paſſion on the nerves, and, ſyſtem, is often unfortunately obſerved in nurſes giving ſuck, and frequently occaſions convulſions in infants, and lays the foundations of abſceſſes and cancerous diſeaſes, the conſequences of inflammatory affections, and obſtructions, in the breaſt, to be traced to this ſource. *M. Parmentier* (med. mem. Paris) obſerved, that milk drawn immediately after a nurſe had recovered from an hyſteric fit, to which ſhe was ſubject, was *thin*, *colourleſs*, and *pellucid*; in an hour after, it was gelatinous, and after a few hours, and not ſooner, it returned to its colour: the ſame alterations were renewed by ſucceeding paroxyſms. This is analogous to the limpid urine of hypochondriac's; it affords an important caution to nurſes, and well illuſtrates the œconomy of nature, in guarding by this peculiar apparatus of ganglions, our ſecretions from ordinary impreſſions of mind, which in a more excited ſtate are ſo injurious: for in the ordinary and quiet ſtate of mind and body, the mind has no influence over the glandular ſecretions, and can neither incite nor retard the velocity of liquors thrown into the glands.

8. To eſtimate the comparative degrees of nervous power and energy, neceſſary to the production and continuance of voluntary motion and ſenſation, we muſt have recourſe to the phænomena of diſeaſes, and chiefly of palſies, in order to calculate the difference, and make a compariſon, which, ſo far as I recollect, has not been aſcer-

tained by experiments. The number of patients, who, in palſies, loſe the power of voluntary motion only, is vaſtly greater than that of thoſe, who loſe ſenſation along with voluntary motion: the inſtances in which ſenſation, together with voluntary motion, is completely loſt, are very rare, and attended with a clear expectation of death, ſoon followed by an apoplexy, which verifies the prediction. Hence it appears that to voluntary action, a greater and more perfect nervous energy is required, than what is neceſſary or requiſite, to convey mere ſenſory impreſſions.—For the moſt part, *ſenſation remains*, after paralytic ſeizures take away all power of voluntary motion, and is very rarely loſt, but with the approaching extinction of life. I remember a few ſtriking inſtances, in which the paralytic limb was ſo completely inſenſible, as to ſeem to the patient no part of his body; and to belong to ſome other perſon. Such was the firſt approach to apoplexy, which in a fortnight after, ended the life of my venerable father, in the eighty-ſeventh year of his age.

Omnia debemur vobis; paulumque morati,
Serius aut citius, ſedem properamus ad unam.

Ov. Met.

9. I have, in my firſt Eſſay, ſhewn, that a con-

tinuation of the vital and ſpontaneous motions in apoplexies, is owing to the nervous ſupport, the heart and organs connected with it, derives from the ganglions and the nerves below them. This is equally applicable to a very frequent diſeaſe, the hydrocephalus internus; a diſeaſe as generally fatal as it is frequent, The ſon of an able ſurgeon, four years of age, after an illneſs of ſome weeks, in which the chief complaint appeared to be, languor and pain in the bowels, was at length ſeized with vomiting, followed with ſymptoms of preſſure of the brain: after one convulſive fit, he lay completely inſenſible for three or four days. After death, three ounces of lymph were found in the ventricles of the brain. The pupil had been vaſtly dilated, and was immoveable by the approach of light. He poſſeſſed no ſenſe of ſeeing, hearing, ſmell, taſte, or feeling, for the laſt three days. I think indeed the ſenſes in this diſeaſe are more completely extinguiſhed, than in apoplexy: yet the motions and force of the heart, were very little diminiſhed for ſome days. This caſe repreſents nearly others of the kind. The pulſe, in the ſtage of vomiting and irritation, is irregularly quick: when ſtupor comes on, it is then ſlow and regular; reſpiration is rare, often interrupted with a ſigh. Juſt before death the pulſe becomes quick again, but with little force in the ſtroke.

In this diſeaſe the functions of the heart and inteſtines are ſupported, long after the powers of voluntary motion and ſenſation are completely extinguiſhed: this ſupport they derive from the ganglia. An attention to the courſe of the diſeaſe, much elucidates the dependance of the different functions of various parts, in different degrees of preſſure, on the brain. When water begins to be collected, and *before its accumulation*, the beginning effuſion acts as a ſtimulus, or irritation, on the brain and origin of the eighth pair of nerves, and produces pain in the ſtomach, nauſea, and vomiting: when conſiderable accumulation has taken place, the preſſure that reſults, extinguiſhes *voluntary motion* and *ſenſation*; and no powers continue to manifeſt or ſupport life, except ſuch as depend on the great ſympathetic nerves and ganglions: viz. thoſe of the vital organs and involuntary motions.

In the hydrocephali, which often takes place in the infant ſtate, before the ſutures are cloſed, (and the brain confined by a complete oſſification of the canium,) it is wonderful to obſerve, to what a degree and extent, the brain may be ſtretched, ſo as to reſemble a membraneous bag, of very large capacity: in this ſtate life often laſts, for a very conſiderable time, with faculties much leſs impaired than could be ſuppoſed and expected.

Reſpecting the vomiting which happens in attacks of this diſeaſe, in apoplexies, and in wounds, by which the brain is injured, it deſerves to be recollected, that this ſymptom is alſo one of the conſequences of inciſions and ligatures of the eighth pair of nerves, along with thoſe of the intercoſtal nerves, as ſtated in a note of my former Eſſay.

10. The greater irritability of the heart and of the inteſtinal canal, than of the fibres of muſcles ſubject to voluntary motion, is particularly obſerved by ſuch as are converſant in comparative anatomy. Nor have phyſiologiſts been able to account for the difference, by any thing obſerved in the muſcular fibres in theſe parts: and no obſervation hitherto made, prevents us from concluding, that the muſcular fibres, in the heart and inteſtines, except in retaining the property of irritability much longer, and more tenaciouſly, are perfectly ſimilar to fibres in all other muſcles.

This ſuperior irritability in the heart, and other parts poſſeſſing it, is derived alſo, from the ganglions ſituated on the nerves, which are diſtributed to theſe parts.——By them, thoſe occaſional exertions of volition, and exerciſe, which require reſt, and ceſſation in the voluntary muſcles, are prevented from extending to the involuntary organs: by them, theſe organs, though ſo exquiſitely irritable,

table, are rendered to a great degree inſenſible. Hence the energy of the brain, which is conſtantly proceeding to *inſtaurate* every part of the nervous ſyſtem, and receives probably *augmented power* in the ganglions themſelves, remains wholly appropriated to the uſe and ſupport of the important and inceſſant motions going on, by the eſtabliſhed order of the Creator, in the involuntary organs: and undergoing no dimunition or exhauſtion, by voluntary excitements, and by the waſte, which takes place from the exerciſe of thought and ſenſation in the natural actions: the organs of involuntary motion, have no need of reſt, like others, and while life remains they never ſleep: hence that durable irritability in the fibres of the heart; and appearance of life in them, after the death of the reſt of the body.

It is obſervable that the heart and other involuntary organs, are moſt irritable in young animals: a proof this property does not originate from habit, as has been ſuppoſed, and is not ſtrengthened by it; but, is placed in the original fabric of animals, and ſupported in thoſe parts by the ganglia of the nerves.*

11. The ganglions, by the ſame organization

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* Baron *Haller* on ſenſible and irritable parts of animals, p. 55.

which checks voluntary motion in the vital organs, render thoſe organs very obtuſely ſenſible.—Baron *Haller* has ſhewn that exquiſite irritability in theſe parts and others, is perfectly compatible with dull ſenſation. This obſervation was much combated by his antagoniſts, and was not underſtood perfectly, in its true cauſe, by himſelf. "Irritability, ſays he, differs entirely from ſenſibility, and the moſt irritable parts are thoſe which are not ſubject to the command of the ſoul."*

Irritability depends on the connection of muſcular fibres, with the matter of the nerves; but ſenſations depend upon impreſſions conveyed by ſenſory nerves, nerves deſtitute of ganglions, and rarely united in plexus, to the ſenſorium, or ſentient being; the impediments to volition, are alſo impediments to vivid ſenſations: hence in the involuntary organs, in the heart eſpecially, ſenſation is dull, but irritability very great. In the voluntary muſcles, ſenſation and irritability are nearly equal. Had irritability, as ſuppoſed by Baron *Haller*, depended upon the animal gluten in muſcular fibres, only, the fibres in muſcles ſubject to the will, having as much of that, as the involuntary muſcles, muſt have equalled them in irritability. I notice this only curſorily, and willingly acknowledge the obligations we owe to this great

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* Ibid, p. 59.

man: my homage to his unremitting diligence, and ardent purſuit of knowledge.

12. Though volition, on account of the interpoſed ganglia, does not extend its power over the heart and inteſtines; and though the ſame means prevent theſe parts from giving us any ſenſible notice of the ſtimuli, which excite natural motions in them, and make us often equally inſenſible to weaker morbid ſtimuli; yet under much emotion and agitation of mind, the heart more eſpecially ſuffers, as well as from uneaſy feelings, leſs vehement in the moment, but of longer duration, ſuch as fear, ſorrow, grief, &c. long harboured in the mind.

Theſe principles properly underſtood and applied, may, if I miſtake not, give light to a great number of facts in pathology. In purſuing theſe reſearches, I hope and believe, I have not been led on by vain and uſeleſs curioſity; but by a conviction, that the light thrown on the uſes and functions of the ganglions and viſceral nerves, may guide us in the diſcovery of diſeaſes, of great importance to be diſcriminated in their nature and ſeat, in order to be treated with ſucceſs.

The examinations of dead bodies, in the immenſe collections of *Bonetus*, *Morgagni*, and *Lieutaud*,

taud, furniſhes ample evidence, how frequently, or rather how conſtantly, fatal diſeaſes are formed in the vital organs, and in the abdominal viſcera: how frequently theſe parts are conſumed by collections of water and pus; tumours, adheſions, and inflammations are formed, of which attending practitioners had no ſuſpicion. Even the great *Harvey* ſays he never opened a body, without learning ſomething unknown to him. So inexhauſtible is nature in inſtruction to attentive ſcholars. Often, indeed, we ſhall find, in conſequence of our moſt accurate reſearches, that the patient who looks to us for health, labours under an incurable and fatal malady. That he has incurable ſcirrhoſities, inacceſſible abſceſſes, the pericardium diſtended by water, aneuriſms in the thorax, the organs of circulation obſtructed by mal-confirmation, as well as accidental diſeaſes: what advantage do we derive from ſuch painful diſcoveries, but the mortification of knowing the impoſſibility of finding adequate remedies, and, of giving the relief expected from us? Knowledge, nevertheleſs, will ſave the phyſician the mortification of attempting impoſſibilities, or aggravating miſery by additional miſchiefs: I ſhall therefore hazard a few more obſervations.

13. Beſides the diſeaſes by which the heart ſuffers from ſympathy, a cauſe extremely exten-

ſive in its effects, and often occult in its modus operandi, it has a numerous train of maladies peculiar to itſelf: theſe have been examined with much diligence by *M. Senac.* But as ſcience is progreſſive, and nature inexhauſtible, thoſe diſeaſes ſeem capable of much illuſtration, from the principles I have endeavoured to explain; and which lead to truths he had no notion of, and throw light on the facts he has collected, with an induſtry and ſolicitude, which might make ſome perſons bluſh; who, to keep their ignorance in credit, attempt to deride that knowledge, which is the only guide to ſalutary practice, and which alone confers a right to the name of phyſician. The heart, ever unaffected by volition, is nevertheleſs, by its connection with the nerves and blood veſſels, ſtrongly and quickly agitated by the irregular and morbid movements of the body to which it is fixed, as well as by its proper and peculiar diſeaſes. Irritations, which hardly affect the ſenſes, agitate the heart. In fevers, the forces of the heart are ſometimes excited, and ſometimes weakenod, but are always quickened and diſordered. Yet the cauſes of fevers are for the moſt part, not only unperceived by the ſenſes, but are ſeldom to be diſcovered by induction. In fine, the heart, which ſeems the primum mobile, dies, and has its motions extinguiſhed, by the deſtruction of parts it ſeems to animate. The prick of a finger, a finger, ſays *Senac*, the wound of a nerve, a locked jaw, an abſceſs, a beginning mortification in any internal part, and often in thoſe that are external, lays the heart in fatal inaction, in ſuch an unaccountable manner, that we frequently know as little why we die, as how we live!

14. The obſcure and very dull ſenſation of the heart, makes us perfectly unconſcious of its natural movements, though ſo frequent, ſo various, and ſo important to the ſupport of life. Even its palpitations, are ſenſations of its impulſe on the left ſide, and not of the heart. Hence it ariſes, that in the chronic diſeaſes of the heart, the pains which reſult, are always diſtant and ſympathetic. Thus in the diſeaſe lately known by the name of angina pectoris, it is characteriſed by pains acroſs the breaſt, and at the inſertion of the deltoid muſcles in the arms, attended with anxiety, which deeply affects the patient's mind, and ends in ſudden death. On opening the body, the heart has been often found affected in its valves, muſcular ſubſtance, the ſtate of the great veſſels, or contents of its cavities. Likewiſe cardialgia, or pains in the epigaſtric region, with palpitations there, often ariſe from diſtenſion of the heart: and in general, the uneaſy ſenſations which accompany or ariſe from the enlargement and dilatation of the heart and its veſſels, ariſe

from its preſſure on the mediaſtinum, the lungs, the pleura, and diaphragm, and are not properly painful ſenſations immediately from the ſubſtance of the heart itſelf. This ſeems to have been obſerved by the ancients, and a few of the modern phyſicians. *Hippocrates* has ſeveral obſervations which evidently relate to the diſeaſes of the heart. For inſtance: "Quibus—adſit etiam cordis, ſeu potius oris ventris dolor, hi ubi longius œgrotarunt peripneumonicorum modo moriuntur."—Coac. Præn. § 1.

"Oris ventriculi dolor ſeniorem frequenter Impetens, mortem repentinam ſignificat." Ibid. See *Banniſter*'s caſe. On the whole it is certain, the moſt dangerous diſeaſes may be formed within us, may ſap the vital organs, and prepare our ſudden extinction, without giving us any previous alarm.

15. Inflammations in the heart occur frequently: they may be diſcovered by an attentive, ſagacious practitioner, but in general they paſs unknown and unobſerved, in dangerous peripneumonies and other inflammatory diſeaſes of the thorax. The want of pointed pain, occaſions the ſtate of the heart not to be thought of: *Boerhaave* has well obſerved, that anxiety is the ſenſation peculiar to carditis: 'twas alſo the principal ſymptom

tom in the following melancholy caſe; in which a diſeaſed ſtate of the heart, which had followed a fall from a horſe ſome years before, ſeems to have diſpoſed the noble patient, to the inflammation and enlarged liver, which proved fatal to him, notwithſtanding the able exertions of his phyſicians.

E. W. was for ſome years ſubject to palpitations, which he imputed to an injury he received on his left ſide, by a fall from his horſe, during the American war.

In September, 1789, he began to complain of ſevere pain in the right hypochondrium, which encreaſed, notwithſtanding bleeding and other remedies, and was accompanied with frequent paroxyſms of extreme anxiety, during the progreſs of the diſeaſe, which continued till about the middle of October, when it terminated in death.

He frequently cried out in the agony of anxiety; but ſaid the uneaſineſs which affected him was not what is uſually called pain, but intolerable anxiety and inquietude. His pulſe, during the greateſt part of the illneſs, was feveriſh, very quick and ſtrong, till within a few days of his death, when it intermitted. He died highly delirious in the thirty-eighth year of his age. On examining his body in the preſence of his phyſicians, The membrana adipoſa was found tinged of a deep yellow colour.

The liver, at its anterior and ſuperior part, was indurated, to an extent of not leſs than five inches in diameter, and protuberated forwards; other parts of it had ſome induration, and its whole ſubſtance had ſtrong marks of congeſtion.

There were alſo ſome adheſions from the liver to the diaphragm, as alſo to the peritonæum and inteſtines.

The pancreas was indurated. There was not any thing unuſual in the other abdominal viſcera.

In the cheſt, the heart was found conſiderably larger than uſual, cloſely embraced by, and ſtrongly adhering to, its pericardium.

The lungs did not appear diſeaſed; but the left lobe was compreſſed into a ſmaller ſpace than in its natural ſtate, from the increaſed ſize of the heart.

The adheſion of the pericardium to the heart, its enlargement, and the compreſſion of the left lobe of the lungs thereby, muſt greatly impede the motion of the blood, through the pulmonary blood veſſels; and alſo make its return from the liver difficult, and thus contribute to its accumulation in that viſcus: and thence aroſe thoſe ominous feelings of agonizing anxiety and inquietude, without pain, which the patient complained of many days preceding his death.

Veſtiges of inflammation are frequently found in the heart in diſſections: ſometimes the pericardium is thickened, and water or pus contained in it; ſometimes purulent eroſions are found in the ſubſtance of the heart, or it is inveſted with the buff, or inflammatory cruſt. In a ſubject examined by my diligent and ingenious friend, Dr. *Cheſton*, the conſequences of inflammation were very numerous. The pericardium contained three pints of a bloody fluid: the internal ſurface of this bag, was much thickened, and beſet with fleſhy granulations; in other parts its appearance was reticular, like the honeycomb of the inteſtines.

The external ſurface of the heart, in every reſpect, reſembled the appearance of the pericardium. The lungs adhered almoſt univerſally to the pleura.

I was conſulted December 28, 1787, for *M. C.* a maiden lady, in the fortieth year of her age: ſhe had taken an emetic, which left much irritation. For two months ſhe had ſuffered by palpitations of the heart, *felt under the ſternum*, as well as in the left ſide: pain under the ziphoeid cartiledge: cough without expectoration, ſhort breath, pulſe very irregular, and hardly to be felt in either wriſt: ſhe derives a temporary ceſſation from pain from camphore julep, with a little æther and ſyr. de mecon, and pills of aſſafœtida and extr. cicutæ.

January 2, 1788, the left jugular vein was obſerved to beat like an artery: which I have ever obſerved to be a ſymptom of encreaſing danger, from collections of ſerum in the thorax: ſhe died 11th; and her body was opened January 19, by Mr. *Ruſſel.*—A quart of water was taken from the left ſide of the breaſt, and, the lobe of the lungs; on that ſide, was compreſſed to one fourth of its uſual ſize: the lungs of the right ſide were large and ſound. The dorſal vertebræ gibboſe.

The *heart* adhered firmly to the *pericardium*, and *this* to the *pleura*, *mediaſtinum*, and *diaphragm*: Its apex, or point, being attached to the diaphragm under the ziphoeid cartiledge, (where pain had been chiefly felt,) and directly downward and backward.

The ſtomach was large and flaccid; the liver enlarged, but ſound; ſoft biliary concretions were found in great numbers in the gall-bladder, though ſhe had never laboured under jaundice.

The preſſure of ſo great a quantity of water, added to the morbid adheſions of the heart to the pericardium, and of that, to the ſternum and diaphraghm, had impeded the motions of the heart, and occaſioned them to be felt under the ſternum and pit of the ſtomach. This ſituation preventing the right ventricle from exerting its natural contractile power, to propel the blood with proper force into the pulmonary artery, it paſſed from thence into the left ventricle, and, into the aorta and arteries, with a feeble undulatory motion, ſo that regular pulſations were hardly felt at the wriſt.

The blood being reſiſted, by the preſſure of the collected fluid, in paſſing through the lungs, the right ventricle of the heart became diſtended, and reſiſted the entrance of the blood from the vena cava; and, the re-action from this reſiſtance, occaſioned a pulſatory, or undulatory motion, reſembling pulſation, in the jugular veins. It is ſaid none of theſe ſymptoms appeared till after the emetic was given, which was followed by great encreaſe of irritation, and ſuch ſymptoms of inflammation, as occaſioned the patient's being bleeded.

William Banniſter, æt. ſeventy, admitted April 9, 1792, in-patient in the Infirmary, for a ſore leg: complained of pain at his ſtomach, with ſtrait, and difficult reſpiration. On the third of May he died ſuddenly—body opened—the breaſt, abdomen, ſtomach, and viſcera in the abdomen, ſound: omentum emaciated.

Thorax. The pericardium adhered in an uncommon extent, to the muſcular and anterior part of the diaphragm, as well as to its tendinous part.

The right lobe of the lungs entirely adhered to the pleura, and mediaſtinum; a preceeding inflammation had cauſed all the adheſions.

The left auricle of the heart was extended to an uncommon degree; and when emptied of blood was larger than uſual. The diameter of the aorta enlarged, its valves entire; oſſifications were beginning, where the valves join the artery.

The pain felt from the adheſion of the pericardium, was naturally referred to the ſtomach, and was accompanied with ſenſe of tight confinement, and difficulty in breathing. His pain was relieved, but not removed, by ſmall doſes of tinct. aloes and tinct. amara. The ulcer in his leg, was not healed at the time of his death. Hence it ſeems, iſſues do not certainly prevent ſudden death in the angina pectoris, as has been ſuggeſted. But, on the other hand, I have often obſerved aſthmatic ſeizures follow the cloſing of old ulcers in the legs.

No water was found in the pericardium. The heart was larger in ſize, and its ſubſtance of a pale livid colour, and leſs firm than uſual.

The adheſions muſt have rendered reſpiration laborious, and prepared other hidden cauſes of ſudden death: we are not always to expect to ſee the cauſes of ſuch alarming events; as they are often inviſible and latent: they may ariſe from ſudden ſpaſm, from ſympathy, as in the action of laurel water, or a ſudden blow on the pit of the ſtomach, which is frequently fatal, or from a defect of irritability in the muſcular fibres, or ſome unknown alteration in the brain, nerves, or ganglions: ſo various are the ſtrokes which precipitate us to the grave.

In all theſe caſes, and others ſimilar to them, the pain in no ſtage of the diſeaſe, is at all equal to the extent of the miſchief, which appears in diſſections.

16. Inflammatory diſeaſes of the heart have been found frequent and general, at certain ſeaſons, and in particular circumſtances.

Dr. *Huxham* (Ph. Tranſ. abridged, vol. ix. p. 135) gives an account of the prevalence of ſuch a diſeaſe, in a number of ſeamen, returning from a warm Weſt-India climate, into the Engliſh channel, in February and March, 1742, during exceeding cold dry weather. They were ſeized with ſhort, importunate, aſthmatic coughs, without expectoration: violent, and almoſt perpetual palpitations of the heart, with a conſtant intermitting trembling, fluttering pulſe; and a conſtant anxiety, pain and ſinking of the heart, as they expreſſed it. Exceſſive difficulty in breathing, and pains of the ſide in ſome patients, though with very little fever.

Twenty perſons labouring under ſuch ſymptoms died, notwithſtanding the ſkilful exertions of this eminent phyſician.

The bodies of two patients were opened. Large and uncommonly tough white polypi, were found interwoven in the carneæ columnæ of the ventricles of the heart. The branches of theſe polypi ſhot a great way into the aorta, and its branches: one of the ſemilunar valves was, moreover, beginning to oſſify.

Theſe caſes were clearly inflammatory diſpoſitions of the heart: and it appears that the ſame cauſes which generate pleuro-pneumies, may render carditis a frequent illneſs.

17. The eleventh article of the firſt vol. of Memoirs of Med. Society of London, gives an accurate hiſtory of the caſe of *John Judd*, aged twelve years. After a fall, a year back, he complained of pain and unuſual oppreſſion about the ſtomach and breaſt, which were much encreaſed by eating ſolid food.—The left ſide of the thorax was much enlarged, and there a ſtrong pulſation was obſerved, extending with an undulating motion to the pit of the ſtomach, which was diſtinctly ſeen, even when covered by his waiſtcoat: this continued till his death, and he ſaid, it felt, *as if his heart was rolling about like a great ball.* His pulſe was low and weak, but neither quick nor irregular.

Another fall haſtened his death. Water tinged with blood was found in the thorax. The lungs adhered in ſome places to the ribs and diaphragm. On removing the pericardium and heart out of the body, marks of inflammation were found on the ſurface of the heart: to which the pericardium adhered ſo ſtrongly, that no force could ſeparate them. The heart was enlarged to three times its natural bulk, and appeared like an unformed maſs of fleſh. The cavities of the heart were not larger than uſual, and its enlargement conſiſted entirely in the thickening of its muſcular ſubſtance. See a caſe in ſome reſpects ſimilar, in art. 23, of vol. 2, of Medical Eſſays of Edinburgh.

18. The following caſe, perhaps, began with inflammation, though its termination and nature were very different.

John Townley, æt. ſixteen, became my patient in our Infirmary, January 6, 1793: he complained of great difficulty in breathing, and had ſpit blood by coughing, for ſome months paſt. His countenance was *uncommonly livid.*

I ordered him to take the following pills in the morning and evening, and the draught four times in the day; and he had ſome relief from them, eſpecially in moderately opening the body. R. Pil. ſcill. ſcrup. iv. extr. cicut. ſcrup. ii. f. pil. xxx. R. Nitri puri, ſcrup. i. mannæ drach. i. aq. hordei unc. i ſs. f. hauſtus.

He died January 18.—The ſymptoms immediately preceding his death, and the appearances in diſſection, are thus related, by my ſon, Dr. *John Johnſtone*, from his own obſervation and inſpection.

An hour before his death, his face and hands became of a darker purple colour; he could not ſit up, and ſat leaning with his elbows on his knees. His breathing was extremely laborious, but he complained of no pain. No pulſe was now felt at the wriſt: though the pulſations of the heart were ſtrongly felt in the ſide.—On diſſection, the liver was obſerved of a deeper purple colour than common. The inteſtines were loaded with fæces, and part of the ilium was ſlightly inflamed; there was alſo an intus-ſuſception of the extent of an inch. The left ſide of the great arch of the colon was extremely contracted, ſo as to be much narrower than the ſmall inteſtines: and half a pint of ſerum was found in the abdomen.

On opening the cheſt. The lungs were *white*, and full of tubercles: more than half a pint of a ſerous fluid was found in the pericardium: the ſubſtance of the heart tender, but of the natural ſize: the left auricle and ventricle, were extremely diſtended with blood, half coagulated: all the auricles and ventricles were full of ſuch coagula, and white polypi.

Two of the ſemilunar valves were cartilaginous, and ſo much indurated, as to make it probable they did not completely cloſe, and, that the projected blood, might again fall back from the aorta into the ventricle. Moreover, the white appearance of the lungs, the colour of the blood, and livid appearance of the patient, make it probable, the blood had not been ſufficiently oxigenated in its paſſage to the left ventricle of the heart. Hence a defective irritability, and its power, was inſufficient to propel the blood in the arterial ſyſtem: from its recoil and remora, the diſtenſion of the left ventricle enſued, and polypi were generated, and death terminated this incurable diſeaſe.

Mr. *Senac* has a very ſingular obſervation, viz. That abſceſſes in every part of the body produce ſyncope, except abſceſſes in the brain: if this is generally true, it ſhews that the dependance of the heart on the ganglions, is not only direct and immediate, but greater than its dependance on the brain.

I have dwelt the longer on obſervations of this kind, becauſe, though it is generally known that the heart is acted upon by the paſſions, and by the irregular and morbid movements of every part of the body to which it is fixed, as well as by its proper diſeaſes, yet it has not, ſo far as I know, been ſufficiently *noticed*, that the proper diſeaſes of the heart, are to be diſcovered chiefly by their *action* and *effects, upon diſtant parts*, by the connection and communication, of the nerves diſtributed to them: and the greateſt attention and ſagacity will be neceſſary to diſcover its latent maladies, latent from its dull ſenſation, eſpecially in their early attacks; yet ſuch ſagacity, aided by experience, will often be ſucceſsful in the reſearch, however difficult.

19. The *iris*, is another part, the ſenſibility of which is much inferior to its irritability: the law by which its involuntary movements, depend on the impulſe of light on the retina, has been ſtated in my firſt Eſſay; but there are deviations from this, depending on peculiarities and morbid circumſtances, as appears in the obſervations of *M. Wenzel*, the younger, on the operation of the cataract.

The motions of the pupil, regulated by, and uſually proportioned to the degree of light ſtriking upon the retina of a ſound eye, are produced by the action of the ciliary nerves diſtributed to the iris, and theſe ſpring from the lenticular ganglion.

Among the ſymptoms, that promiſe ſucceſs to the operation of the cataract, a free motion of the pupil, and that degree of mobility, which manifeſts itſelf by its quick contraction, upon a ſudden expoſure to light, is very deſirable.

But

But this experienced oculiſt, has known ſome pupils retain the power of contracting and dilating, though the optic nerve be totally paralytic: though it much oftner happens, when the optic nerve is paralytic, that the pupil is nearly, if not entirely deprived of the power of motion: this ſtate of the optic nerve is known by the total inability of the eye to perceive the difference between day and night.

There are alſo perſons whoſe ſight is good, and yet the pupils of their eyes, upon the moſt attentive examination, in different degrees of light, diſcover no motion whatever.

The caſes related by this author, ſhow that the cataract, had been extracted from ſeveral eyes ſo circumſtanced, and, with the moſt perfect ſucceſs: and, he has frequently remarked, that after the operation has been moſt ſucceſsfully performed, and the light has been reſtored as completely as poſſible, the pupils have, notwithſtanding, often remained almoſt without motion. § 9. p. 52.—ſeq.

It appears from caſes, 6—18—27—28,—and others, that the immobility of the pupil, often proceeds from the preſſure, and other conſequences, of the diſeaſed chryſtaline humour, and, of the diſeaſed ſtate of the capſula of the chriſtaline humour adhering to, and, preſſing upon, the nerves of the iris: the effects of which may remain after the diſeaſed capſula and chriſtaline are removed.

But, the natural ſtate of the iris, is to be inſenſible, and highly irritable, by light ſtriking on the retina, and involuntary in its motions. *M. De Haller* obſerved, that the cornea is pierced through without pain: and it is known to operators on the eyes, and has been remarked by perſons whoſe eyes are operated upon, that very little pain is felt in the operation of couching, or, extracting the chriſtaline. I have ſeen a patient, at the time the needle was in the eye, and while the operation of depreſſing the chriſtaline was going on, aſk whether the needle was in the eye or not.

SECOND PART.

We are unconſcious of internal ſtimuli—Sympathy—Poiſons—Opium—Its power, uſe, and abuſe, &c.

1. THE intimate connection of every part of the body, with the whole, could not eſcape the obſervation of phyſicians and philoſophers.

It was acknowledged by *Hippocrates*, and has not paſſed unobſerved, in the common ſenſe of the people.

2. Some theoriſts, have affirmed it as a principle in phyſiology, that each individual nervous fibrile, extends, diſtinct and unconnected, from the brain to the muſcle, or ſenſory point, in which it terminates.

This is far from being proved. The medullary matter in the brain, and in its terminations, when diveſted from the membranes, with which ſingle nerves are covered, in their courſe to their terminations, have no fibrous appearance: and, beſides the more complicated unions of the nerves in ganglia, unions leſs intricate, are perpetual in the ſpinal marrow, and in the plexus of nerves diſtributed to the limbs.

3. This communion of nervous ſubſtance in its courſe, as well as in the brain, ſeems the chief cauſe of that univerſal ſympathy, which ſubſiſts in the animal body, betwixt each part and the brain, and betwixt one part and another, in certain circumſtances. Some of theſe I ſhall notice; but, it is not improper, before we enter upon ſuch particulars, and, indeed, as an introduction to them, to take notice of that obſcure ſenſation, and unconſciouſneſs of ſtimuli, and of irritations, both natural and morbid, obſervable in the organs which derive nerves from the ganglions of the ſplanchnic nerves.

4. This unconſciouſneſs, has not been obſerved, or at leaſt applied, to any purpoſe, in phyſiology or pathology: and, a ſuppoſition that all internal parts, were acutely ſenſible, was objected to the uſes, I aſcribed, to the ganglions of the nerves: the objection, gave me occaſion to call out to obſervation, the important truth, that the internal organs,

gans, are deſtitute of diſtinct pointed ſenſibility. The very ingenious profeſſor *Whytt*, in the chapter on the ſympathy of the nerves, in his work on the nature, cauſe, and cure of hypochondriac and hyſteric diſeaſes, has objected to ganglia having any concern in ſympathy, what follows:

" If there were any anaſtomoſis, or real communication between the nerves of the ſame or different trunks, either in the ganglia or elſewhere, it is natural to think, that a confuſion would neceſſarily happen in our ſenſations, as well as in the motions of our ſeveral muſcles; for the impreſſions of external objects, would be *communicated at the places of union*, to other nerves than thoſe affected: and the change produced by the will in any nerve, at its origin in the brain or ſpinal marrow, in order for moving a particular muſcle, would affect all thoſe nerves, with which it has any communication, by means of the ganglia or otherwiſe." p. 40.

This needs no other anſwer than what was given by me long ago,—that ganglia intercept volition, and alſo render ſenſations obſcure and indeterminate, in the ſplanchnic organs: facts theſe in the animal œconomy, which make it probable, that there is actually that intercourſe and communication of various different nerves in ganglia, obſerved by anatomiſts; and ſpeculations, however ingenious, muſt yield to facts.

5. The heart, the inteſtines, and moſt of the abdominal viſcera, being inſulated, by means of the ſplanchnic nerves, from the voluntary and ſenſory powers of the mind, we are thereby rendered unconſcious of the irritations, which act upon the heart, and perpetuate its motions. The nerves of the ſtomach and bowels, both in health and in ſickneſs, in the natural action of digeſtion and chylification, are ſtimulated; and yet theſe ſtimuli excite no perceptions in our minds, ſimilar to the impreſſions produced by ſtimuli in the ſenſory organs, or other ſenſible parts.

The ſecretions in the liver, pancreas, kidneys, and other glands, go on in a natural ſtate, without any perception, of which we are conſcious: and dangerous diſeaſes, are formed in thoſe parts, though we are inſenſible of the ruin, that is undermining health, till the functions of the ſtomach, or of ſome of the viſcera, are ſo far perverted, as to be at length felt, by conſiderable pain, or other ſufferings ariſing from thence: for irritation in thoſe parts, does not produce pain, till it be very great.

6. We take into the ſtomach food, and a great

variety of refreſhments: the ſenſe of hunger is removed by them, and we feel ourſelves ſuddenly invigorated, without any other peculiar ſenſation of the alimentary ſubſtances, which produce this refreſhment, and which, by their action upon the nerves of the ſtomach, have the moſt extenſive influence.

If medicines are taken, we have no conſcious feeling of their preſence in the ſtomach, if not given in doſes which create nauſea, or which, in ſome other reſpects, diſturb the ſyſtem. Their action is only known, by their good or bad effects, and not from any immediate impreſſion, of *diſtinct* ſenſation.

However ſenſible every one is of the diſtinct taſtes, of different kinds of food and liquors, of the taſtes of vinegar, pepper, ſalt, ſugar, fruits, and wines, of different kinds, in the mouth, we feel that difference no longer, after theſe matters reach the ſtomach: they produce no other ſenſation, on the coats and nerves of that organ, than the removal of the uneaſineſs and languor attending hunger, with a ſenſe of general invigoration and refreſhment.

7. When the ſtomach is overloaded by ſubſtances it cannot digeſt, or, when irritated by exceſs, then

nauſea and vomiting are excited, by theſe ſtimuli acting on its coats: and we are no otherwiſe ſenſible of the ſtimuli, producing theſe effects, but by the effects themſelves, and, a depreſſing feebleneſs and uneaſineſs, antecedent to them.

This ſingular and curious fact, in the animal œconomy, of diſtant parts being ſtrongly affected by ſtimuli applied to the ſtomach and bowels, where, for the moſt part, no particular ſenſation or commotion is perceived, is remarked by Dr. *Gardener*, in a work publiſhed at Edinburgh in 1784, as a remarkable circumſtance in the conſtitution of their nerves.* " For, ſays he, ſtimuli applied to other parts, whatever effects they may have in the ſyſtem, are conſtantly felt firſt in the place where they are applied, which is not always the caſe with thoſe acting on the ſtomach and bowels; on the contrary, their moſt evident effects are often in places remote from the viſcera."

Nevertheleſs, I have often ſeen patients, long martyrs to a morbid ſenſibility and irritability in nervous diſeaſes, complaining of uneaſy ſenſations, and internal emotions; which ſeemed to me to ariſe from the diſturbed and accelerated periſtaltic motions of the inteſtines, become thereby ſenſible and uneaſy to the patient, in like manner as the motions of the heart, are in its palpitations; though we are uſually inſenſible of the natural, and even of the leſs violent morbid movements of theſe parts.

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* The ingenious writer was not ignorant of my opinion, publiſhed twenty years before, on the uſe and effects of the ganglions, that conſtitution of nerves producing thoſe effects, ſo particularly noticed by him.

8. The ſympathy, obſerved in the human body, is univerſal, or, partial. It is likewiſe direct, or, indirect. It is alſo very properly diſtinguiſhed, by the learned *Tiſſot*, into active and paſſive. This ſubject is obviouſly of great extent and importance. The limited view I propoſe to myſelf, in ſelecting a few inſtances of this extenſive range, will relate to ſome ſtriking particulars of partial and direct ſympathy, and afterwards, to ſome that are indirect and paſſive.

In direct ſympathy, the impreſſion is not interrupted, or circuitous, in its paſſage to the brain.—In caſes of indirect and paſſive ſympathy, the nerve primarily acted upon, often appears not at all affected, or, is leſs affected, than that which ſuffers by communication and ſympathy.—In other caſes, the ſenſation goes circuitouſly to the ſenſorium, and does not mark preciſely, and determinately, the part originally affected.

In theſe caſes the ſympathetic ſenſation is generally the conſequence of exceſſive irritation and ſtimulus, producing preternatural action, and pain, in parts on which we are unconſcious of ordinary ſtimuli, and even of morbid ſtimuli of inferior force.*

Such ſympathetic feelings, occur moſt frequently and permanently, in parts whoſe nerves proceed from ganglia; I conſider, therefore, the phænomena as connected with them, as cauſe and effect.

9. The ſympathetic action, or the diſtant ſenſation, ariſing from the original diſeaſe, often appears to be the principal affection, and perhaps the earlieſt notice, of internal diſeaſe. In the abdomen, that ſympathy appears to me reſolvable, into the vague, and, indeterminate, obſcure ſenſations of parts, furniſhed with nerves ſolely from the ganglions,—It is produced, like direct ſympathy, by exceſſive irritation: but in this indirect ſympathy, the painful irritation is not principally felt in its primary ſeat, as it is always, in the caſes of direct ſympathy. Thus it happens, that the connection of the liver with the diaphragm, by the ſuſpenſary ligament, and, from the phrenic nerves ariſing from the third and fourth cervical nerves; and, the

diſtribution

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* On the ſubject of ſympathy, the writings of Dr. *Whytt*, Dr. *Gardiner*, Dr. *Monro*, and Dr. *Tiſſot*, well deſerve attention.

diſtribution of the remaining branches of the third cervical nerve, to the muſcles and integuments at the top of the ſhoulder, and lower part of the neck: from this connection, it happens that an inflammation of the liver, occaſions more pain in the ſhoulder, than is felt in the liver itſelf. Abſceſſes in the lungs, communicating with the diaphragm, or piercing through it, and all violent irritations of that muſcle, which may happen in many other morbid affections of the abdominal viſcera, occaſion the ſame pain in the ſhoulder and neck, and are often accompanied with an ominous ſingultus.

10. The ſtomach ſympathizes with every part of the body, more than any other organ.

Wounds of the head, and injuries of the brain, bring on perpetual vomiting, in the manner, that vomiting is excited by irritations, ligatures, or inciſions of the eighth pair of nerves, in the experiments, which have been ſo often repeated by anatomiſts.

But the head is more frequently affected with pain, and a variety of other diſorders, from a diſeaſed ſtate of the ſtomach, than the ſtomach is from the head.—Injuries of the head muſt be very great, to affect the ſtomach; whereas, wind, acid and bilious humours, lodged in the ſtomach and inteſtines,

tines, with a thouſand other cauſes, not of the moſt ſerious nature, acting noxiouſly in the ſtomach, occaſion dimneſs of ſight, vertigo, pain in the head, hemicrania, and ſometimes end, in producing epileptic fits, and alienations of mind. This has been occaſioned alſo by worms in the inteſtinal canal.

Spaſms in the ſtomach, extènd to the diaphragm, lungs, and throat, and occaſion returns of aſthmatic fits, in perſons ſubject to them, and a ſenſe of ſuffocation in the throat: a tickling of the throat, on the other hand, cauſes nauſea and vomiting.

A nauſea in the ſtomach, whatever may be the cauſe of it, occaſions depreſſion, and ſome irregularity in the pulſe. Hence in fevers, ſuch irregularities, are often forerunners of bilious and critical diſcharges, by vomiting and purging.

Violent and long continued vomiting or purging, as in the cholera morbus, bring on cramps in the limbs.

When the ſtomach is loaded with indigeſtion, or diſtended by wind, languor, dejection, and debility, are felt over the whole body.

On the other hand, when languor and debility are owing to the emptineſs of the ſtomach, or to hunger, the immediate contact of grateful food, or of wine, upon the coats of the ſtomach, reſtores vigour to the body, and alacrity to the mind, before any of theſe ingeſta, can have been received into the blood veſſels, in the form of chyle.

11. It is chiefly by contact with the internal ſurface of the ſtomach, that medicines produce ſalutary effects, and poiſons their baneful conſequences: thus the ſtomach affords us numerous examples of the moſt general and univerſal ſympathy, as well as of every ſpecies of ſympathy. Yet in producing theſe univerſal or particular effects, the mind has no ſenſation of the preſence of ſuch ſtimuli in the ſtomach, and is totally unconſcious of them, but by a grateful warmth, and, invigoration, if they are of a ſalutary kind; and of nauſea, head-ache, dejection, or vomiting, if of a morbid kind.

In a word, it is by the ſympathy ſubſiſting betwixt the ſtomach and the whole body, that medicines act, and cure diſeaſes by their primary, and often, their immediate operation on the nerves of the ſtomach. It is by the contact of opium with this organ, that pain is relieved, wherever its ſeat may be; and when over-doſed, life extinguiſhed. — It is here, the cinchona, removes the morbid ſtate, which cauſes intermittent fevers. The fever which affects the whole ſyſtem, is cured by the contact of that invaluable remedy, upon the internal coat of the ſtomach only.

The ſalubrious powers of aſtringents, bitters, in ſhort, of every ſpecies of medicine, primarily on the ſtomach, produce a conſentaneous, ſalutary alteration in every part, however diſtant: on the ſtate of that organ health depends; and diſeaſes are removed by applications to it.

12. This powerful ſympathy of the ſtomach, and its action on every part of the ſyſtem, is very remarkable in the effects of poiſons of every kind, received into the ſtomach.

Some poiſons, indeed, act moſt powerfully in wounds; and, if ſwallowed, are rendered harmleſs by digeſtion, as the poiſon of the viper and rattle-ſnake: and ſome have extended that ſuppoſition, to the poiſon of rabid animals: But I believe this ſuppoſition has never been aſcertained, by facts, and I certainly do not recommend the experiment, on the human ſubject.

Neither do I ſpeak here, of the aerial, or mephitic poiſons, which appear to deſtroy the vital principle by inhalation, and inſtant contact; and extinguiſh life without a ſtruggle, and ſooner, than it is extinguiſhed in the exhauſted receiver. The effects of vegetable poiſons in the ſtomach, are what I mean to inſtance in a few of them.

13. The American poiſon of the TICUNAS, which is ſo deſtructive, in the ſlighteſt wounds, to animals, though aſſerted to be innocent in the ſtomach, by ſome authors, has been found a deadly poiſon internally, as well as externally, in the experiments of *Fontana.*

But a larger quantity of it is required, to kill even ſmall animals, in the ſtomach, than in wounds. Five grains of it, ſwallowed by a Guinea-pig and pigeons, cauſed death in twenty minutes: eight grains of it killed a ſmall rabbit in an hour. C. iii. p. iv.

The fatal impreſſion made in the ſtomach by the ticunas, is purely nervous: lethargy, convulſions, faintings, loſs of ſtrength, and loſs of feeling, are the common ſymptoms produced by this deadly poiſon.——The mineral acids, are ſaid to deſtroy its power.

14. The poiſon extracted by diſtilling the leaves of the LAURO-CERASUS, in which the diſtilled water

is ſtrongly impregnated with the eſſential oil of the plant, is ſo quickly fatal, when ſwallowed, or when it touches the fauces of animals, that it does not ſeem to yield to the ticuna's poiſon, in the fatal power of extinguiſhing life. With leſs than two tea-ſpoonfuls of this water, taken internally, ſays *Fontana*, I have ſeen middle-ſized rabbits fall into convulſions, in leſs than thirty ſeconds, and die in a minute. If given as an injection, to animals, it equally produces convulſions and death.— When given in a ſmall quantity, convulſions, more or leſs violent, ſucceed, and the body gradually becomes lifeleſs, beginning with the hinder feet. If ſwallowed, in a large quantity, by animals, they die, almoſt inſtantly, without convulſions, and their bodies appear in a very relaxed ſtate. It is fatal in wounds, as well as the ticuna's, but requires a larger quantity to kill in a wound, than when taken into the ſtomach, or given by injection. *Fontana.*——This ought to be conſidered by ſuch as recommend this water, as an external application, to cancerous ſores, and other malignant ulcers.

Dogs and horſes killed by laurel-water, in the experiments of *Langriſh* and *Du-Hamel*, examined after death, had no appearance of inflammation. The ſtomach, and its action, appeared to them

injured

injured and deſtroyed, ſolely by extinguiſhing the power of the nerves.*

Aſſiſted by my ſon, Dr. *John Johnſtone*, I tried the following experiments, with the diſtilled water of the leaves of the lauro-ceraſus.

June 4th, two ſhell ſnails, and two ſnails deprived of ſhells, were put together, in a glaſs of ſtrong diſtilled laurel-water. In a minute or two, they ſeemed lifeleſs and motionleſs: in ten minutes more they were taken out of the liquid, and were irrecoverably dead. On the 5th of June, two more ſnails; and on the 8th of June, four black ſnails, were put into the water diſtilled from lauro-ceraſus: they all died in a ſhort time, much ſooner than in a ſtrong ſolution of opium in water.

July 15, a ſmall young frog, thrown into a glaſs of diſtilled water from lauro-ceraſus, was dead in half a minute: on taking it out immediately, I burnt its toes in a candle, but obſerved no appearance of pain or ſenſation. Of two large frogs, whoſe heads were dipt about a minute in the ſame glaſs of water of lauro-ceraſus: the ſmalleſt was dead in ten minutes, the largeſt in fifteen minutes: on burning the toes of one of them, no ſign, of ſenſibility or life, appeared.

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* Mr. *Doltz*, in Eſſays on Vegetable Poiſons, publiſhed at Nuremberg, found himſelf ſeized with pain in the head, ſtupor, and diarrhœa, for a week, by chopping the leaves of lauro-ceraſus. Thirty pounds of theſe leaves, collected in a room, killed twenty birds out of a hundred, in the ſame room. Two drops of the diſtilled water, killed ſeveral ſmall birds. —The expreſſed oil, and water diſtilled from bitter almonds, was fatal in like manner to a goldfinch, chaffinch, pigeons, and rabbits. A cat became paralytic by eight drops. The water was deliterious in glyſters, in wounds, and injected into the vagina of female animals: wounds became putrid by it. Diſtilled water from box-leaves, yew-leaves, and orange-leaves and hops, were innocent.

Nevertheleſs, when they were opened, the heart of each of theſe frogs, continued their regular pulſations, for a conſiderable time; though they ſhewed no pain, or any other mark of life, when they were opened. This experiment ſhould be re-conſidered by *Fontana*: of my opinions, on the uſe of the ganglions, it is a new proof.

The quickneſs with which ſenſations are conducted by the nerves, ſeems not much greater, than that velocity, with which this poiſon acts, in deſtroying the vital power, in the whole nervous ſyſtem, when applied to any part of it, particularly the ſtomach; ſo immediate is the communication, and ſo quick its fatal effects.

14. Cicuta Aquatica. In the account *Wepfer* has given of the poiſonous power of this plant, its terrible effects, on the nervous ſyſtem, are diſplayed. Seven children eat this root, miſtaking it for a different

a different plant: the conſequences were violent pain in the ſtomach, and a moment after, convulſions and inſenſibility; during which *Jacob Mæder*, a child ſix years old, made water with ſuch force, as to raiſe it five feet high: his eyes were horribly diſtorted, and the teeth and jaws ſo locked, that they could not be opened. He had a ſtrong hiccough, and frequent efforts to vomit, but threw up nothing. A ſwelling of the ſtomach was obſerved, his limbs were convulſed, his back bent backwards like a bow: he died in thoſe convulſions in half an hour. Five of theſe children recovered, but for ſome time complained of great uneaſineſs in the ſtomach. *Boerhaave* ſaw eight children, who had eaten the ſame root, and were affected with delirium, and convulſions: by giving a ſolution of white vitriol, he recovered all, that were vomited by it.

The Conium Maculatum, (cicuta maculata,) though in a leſs degree, produces the ſame effects if over-doſed. The extract is much uſed, medicinally.

Solanum Nigrum. *Lin.* Spec. Pl.

Hortense—Dod. Blackwell, &c. in a large doſe, excites vomiting, vertigo, and cauſes impaired viſion: and, in a ſtill larger doſe, acts as a ſedative poiſon. *Linnæus*, Mat. Med. briefly gives its powers. Vis anodyna, refrigerans, repellens. uſus. Inflammatio, Proctalgia, Scirrhus, Paronychia.

The late Mr. *Gataker*, about the year 1757, recommended it, as a corrector and ſedative for painful impure ulcers. He tried it in ſmall doſes with ſome effect, but afterwards found it unfit for general uſe.

At this time, I made ſome experiments with it. I had formerly obſerved the very ſlow movements, of the heart of ſhell ſnails, in ſummer, when they are moſt lively, its pulſations hardly exceeding, fourteen in a minute.—In the winter, the motions of the heart are conſiderably ſlower, and are hardly perceptible in theſe creatures, till rouſed by warmth or ſtimuli; then perhaps ſeven contractions may be obſerved in a minute.

The heart of a ſnail is triangular, and like the whole animal pale, as the white of an egg. This organ, ſufficiently diſcernible by its pulſations, is protected by the ſpiral ſhell, the proper covering of theſe inſects: and it is ſituated under the ſtrongeſt arch of its ſpinal covering, and, in a part of the body of the ſnail, which is never protruded out of the ſhell, and is moreover protected, by a ſtrong muſcular covering, which corrugates upon the leaſt touch, after the ſhell is broken: ſuch proviſion is made for the preſervation and ſecurity of theſe reptiles.

Like moſt other cold animals, the ſhell ſnail moves briſkly for many hours, after its heart is cut out: yet does not finally ſurvive the loſs and deſtruction of that organ, which ſooner or later cauſes its death, as in other animals.

Having made ſtrong infuſions of the herb, ſolanum lethale, and ſolanum hortenſe, I put ſnails, with their ſhells unbroken, in each of theſe infuſions, ſeveral times; removing firſt of all a membranous covering, which in winter guards the entrance of the ſhell, ſo that the infuſion might reach them. Thus they lay twenty-four, or thirty-ſix hours, in which time they were conſtantly dead, or paſt recovery; the heart at reſt, flaccid, and inſenſible to all ſtimulus. The animal beſides, was either wholly retracted into its ſhell, and, in a rigid convulſed ſtate, or if ſome part, viz. its head protruded out of the ſhell, it was flaccid, as if the animal had died paralytic: this, I afterwards found the appearance of ſnails killed by opium, and diſtilled water of lauro-ceraſus, and other poiſons.

If the ſnails are examined in ſeven or eight hours, after lying in theſe poiſonous infuſions of ſolana, even in that time, the heart is found motionleſs, the reſt of the body as yet retaining ſome languid movement; but leſs lively than what it was capable of, ſeven or eight hours after the heart was cut out.

Snails with their ſhell, and without it, when put in like manner, and, for as long a time in common water, appear to ſuffer nothing, and come out as lively as when they were put into it. I threw ſnails, deprived of their ſhells, and the heart uncovered, into infuſions of ſolanum hortenſe: the motions of the heart appeared at firſt quickened, but in leſs than eight minutes it became motionleſs. The ſnail only not quite dead, moved a little when the head, which ſeems its moſt ſenſible part, was touched.— Other ſnails, in whom the heart was laid bare in like manner, appeared in common water as lively, as they were out of it, as long as I obſerved them.—Theſe obſervations evince the ſtrong ſedative powers of ſolanum, and ſhew that irritability in ſnails, is affected by poiſons, as in other animals, which makes them convenient for ſuch experiments.

16. ATROPA BELLADONNA, SOLANUM FURIOSUM, is a ſedative poiſon in all its parts, its roots, leaves,

and flowers. Vis. Phantaſtica, paralytica, narcotica, anodyna. *Linn.* M. M.

It acts particularly on the nerves of the eyes.

Juncker ſaw a patient rendered blind, by an infuſion of the leaves, taken for a cancer. — *Ray* ſaw a woman loſe the *power* of *contracting the iris*, *even in the greateſt light*, by applying a leaf of this plant, to a ſmall cancerous ulcer near the eye. In others, it only occaſioned ſpots, and other unuſual appearances before the eyes, with weakneſs of ſight.

In children, or others, who have eaten plentifully of the berries, delirium, fury, convulſions, thirſt, and immobility of the pupils of the eyes, expoſed to light, have followed: and, though ſtraining to vomit is a common ſymptom, the irritability and contractile powers of the ſtomach, are ſo far impaired, that large doſes of emetic tartar, are often ineffectual, without other aſſiſtance, ſuch as long continued irritation on the fauces by feathers. Thoſe who cannot be made to vomit often die (See *Ray*, *Lightfoot*, *Plenck*, and others.) In four children, mentioned by *Plenck*, the recovery of ſight was remarkably ſlow. P. 120.

NICOTIANA, TABACUM. *L.*

Acts, as is well known, powerfully as an emetic and cathartic; and, in too large a doſe, as a narcotic, or ſedative poiſon. In a caſe which fell under my obſervation, a ſtrong decoction of tobacco, given as a glyſter, occaſioned, in a few minutes, convulſions and death in a child, to which it was adminiſtered for worms.

HYOSCIAMUS NIGER.

——————— ALBUS.

Qualitas. Viroſa. Vis Inebrians, phantaſtica, Venenata, Anodyna, reſolvens. *L.* M. M.

The laſt is not ſo deliterious as the former.— A ſtrong decoction of it, very ſoon killed ſeveral ſnails, and two frogs. After the decoction had ſtood ſome days, its virulence was abated: and at that time, three frogs thrown into it at night, though much debilitated, were alive the next morning, and ſoon recovered their agility in the open air.

17. DIGITALIS PURPUREA. *L.*

Emetico-catharſim torminoſam, ſingultum, convulſiones, eroſionem oris, ventriculi & inteſtinorum atque mortem cauſat. *Plenck.*

This plant is one of the efficacious ſimples which was uſed in the laſt century, and the beginning of this; and was again laid aſide: though profeſſor *Alſton* ſaid concerning it, as well as the hyoſciamus and ſome other plants, Meliora vix India mittit.

I began to uſe the digitalis for dropſical patients in the year 1776; and ſoon after I was elected one of the phyſicians to our Infirmary, in 1783, I recommended it as a proper medicine for our diſpenſatory. It has come into general practice, as a powerful diuretic medicine, chiefly ſince Dr. *Withering*'s uſeful account of its medical uſe, has been publiſhed. I have uſed it very frequently, and have often experienced its extraordinary efficacy in dropſies: and in hands, who know how to uſe it with diſcretion, it is a valuable medicine, and as ſuch, will probably keep its ſtation in future practice.

I lately made a ſtrong infuſion of the recent leaves of digitalis; the ſmell of the warm infuſion ſtrongly reſembled that of tobacco, (to which, by the way, its botanical character has no affinity,) and the brown colour it aſſumed, being alſo very like an infuſion of tobacco, I was led to give ſome of the dried leaves to habitual tobacco ſmokers; who agreed in calling it, a fine flavoured tobacco.

An infuſion of the dried powder, which I had kept in a cloſe-ſtopped bottle, at leaſt five years, had the ſame brown colour, and ſtrong ſmell, like tobacco: ſo that its powers appear to ſuffer little or no diminution by keeping. I have given this medicine, in its uſual forms, and even in glyſters, with various effects, often ſuch as gave me great ſatisfaction: and, I am now inclined to think, that in aſthmas, and ſome other diſeaſes of the breaſt, it might be ſmoked with advantage.

Two frogs put into the decoction in the evening, were found dead next morning: I found it alſo, though ſlowly, and in a conſiderable time, fatal to ſnails; though ſome of them ſeemed ſuffocated rather than poiſoned, and others but little affected by it.

I have known the digitalis occaſion not only depreſſion, intolerable anxiety, and nauſea, but alſo affect the optic nerves of weak patients in an alarming manner: for ſome, under its uſe, thought they ſaw various different colours on the walls before them. In many it has occaſioned conſiderable itching on the ſkin. Many patients I have happily and ſuddenly cured or relieved in dropſical complaints, ſometimes with, and ſometimes without, an increaſed ſecretion of urine, by means of this medicine: while others have felt no laſting benefit

from

from it, but on the contrary, were injured, by the extreme debility and intolerable nauſea, and ſtill more by the ſudden diminution of the powers and action of the heart, it occaſioned.

Here too the ſympathy of the cardiac nerves, aroſe from the powerful action of the digitalis, on the nerves of the ſtomach.

It appears from the obſervations of *Wepfer* and others, that when the force of poiſons, is inferior to that of producing inſtant death, the convulſions, and other effects of re-action produced by them, are moſt remarkable in parts, at a diſtance from the ſeat of their immediate action. And, it is evident the kidneys, and urinary bladder, are conſtantly much affected by a derangement of nerves, whether that derangement be the conſequence of poiſon, or ſingly of nervous diſeaſes ariſing from other cauſes.

ACONITUM NAPELLUS. *L.*

Its root in powder, was given by *M. Sproegel* to a cat three months old: after much agitation, its hinder legs became paralytic, and it was ſeized with convulſions, and ſlept with its eye-lids very cloſely ſhut. — On the morrow it recovered; and was killed by a drachm, or double doſe of the root it had taken before.

Being opened, the ſtomach contained ſome of the poiſon mixed with food; but was neither inflamed, corroded, extended, or contracted: in a word, it appeared ſound, as did the inteſtines, and other parts, excepting the urinary bladder, *which was ſo contracted, as to be almoſt without any cavity.* *Tiſſot*, Des Nerfs. T. i.—p. 11. p. 58.

The juice of this plant applied to a ſmall wound of the thumb, occaſioned a large ſuppuration, and gangrene, great pains in the arm, alſo, heart-burn, anxiety, fainting, and ſenſe of ſuffocation. *Plenck*, p. 168, Toxicolog.

It is recommended in very ſmall doſes, mixed with ſugar, in rheumatiſm, ſcirrhus, ſcrophula, venereal ulcers, aſthma, and epilepſy, by *Stork*.

19. Papaver Hortense semine Albo, and, more eſpecially, its inſpiſſated extract and juice, Opium.

The attention of phyſicians has deſervedly been turned to opium: in order to aſcertain its powers as a poiſon, and its operation on the animal œconomy, experiments have been tried, on animals of various kinds, by Dr. *Alſton*, Baron *Haller*, Dr. *Whytt*, Dr. *Monro*, *Fontana*, and others.

By the adminiſtration of a ſolution of opium, injected into the ſtomach of a frog, while the membrane of its toes were under a good microſcope, a ſurpriſing diminution of the blood's velocity, in the ſmall arteries, was diſtinctly ſeen, by the worthy profeſſor *Alſton.* In half an hour after, the blood recovered its wonted celerity. By a ſecond and larger doſe, given an hour after the firſt, and, after the recovery of the frog, the blood was ſeen to move much ſlower than after the firſt doſe, and, its velocity gradually decreaſing, it ſtagnated at length; firſt in the ſmaller veſſels, and in almoſt a quarter of an hour the animal expired. One thing was very obſervable,—that notwithſtanding the diminiſhed velocity of the blood, there was no ſenſible diminution of the frequency of the pulſe; yea, when there was no circulation, or progreſſive motion of the blood, the pulſe was viſible by an undulatory motion; that is, the blood returned as far back, at every diaſtole of the heart, as it was protruded by the preceding ſyſtole; this continued till the frog was dead. On opening it, nothing was found in the ſtomach, but a clear mucus, coloured with the opium, of which it was full. This experiment was often repeated, and always with the ſame appearances and event.*

Opium, injected either into the ſtomach or inteſtines of frogs, or even applied to the muſcles of their belly, laid open, produces a paralytic weakneſs, and at laſt ſtupor and death; though the nature of theſe animals is ſuch, that opium does not kill them, near ſo ſoon, as dogs are killed by it.*

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* Dr. *Alſton*'s Diſſertation on Opium, art. 12.—5 vol. Med. Eſſays.

A ſolution of opium injected into the great guts of a dog, in a few minutes brought on a palſy of his poſterior extremities, attended with convulſions and ſtupor. Some days after, the like ſolution, was injected by a perforation through the integuments, into the abdomen of the ſame dog: he became paralytic inſtantaneouſly, and died in a few minutes. Ib. 20. I obſerved in general, ſays *Fontana*, that opium given to animals with warm blood, in moderate doſes, increaſes the force and motions of the heart: the increaſe of reſiſtance in the capillary veſſels, by the torpor induced there, well accounts for this: but, he goes on, if it is given in *a great doſe, it ſeems at once to diminiſh the vigour of the animal, and the force of the heart.*

He made twenty-four frogs ſwallow opium, and inſtantly took the heart from twelve of them, and opened the thorax in twelve others, without taking out the heart.—He found that the effects of the opium, ſooner appeared, in the frogs whoſe hearts remained in the thorax, than in thoſe deprived of it.

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* *Whytt* on the Nerves; and Edinb. Eſſays, Phyſical and Literary.

it. The difference in time was more than one-half. The effects of opium, conſequently, are quicker in animals retaining the heart, than in others depriv- of that important organ. *Fontana*, 2 vol. on poiſons, p. 390 and ſeq.

A drachm of opium given by *M. Sproegel* to a dog of middle ſize, made the animal tremble, and froth at the mouth, as ſoon as it was ſwallowed; he continued in this ſtate, weak and heavy, from nine o'clock in the morning, to four o'clook in the afternoon of the next day. — He was then opened: the periſtaltic motion of the ſtomach and inteſtines, was almoſt at an end; the urinary and gall-bladders were full, ſenſibility very much diminiſhed, the bladder irritated with ſpir. nitri, contracted but little.

The ſame doſe of opium given to a lively cat, made it delirious, and loſe the power and uſe of its hinder legs. On opening the body, yet alive, the periſtaltic motions were not ſo much diminiſhed as in the dog, and the urinary bladder retained its irritability: this cat was opened ſix hours after the doſe was given; hence the periſtaltic motion of the inteſtines, was not ſo completely ſubdued as it was in the dog. In two more dogs, the ſame appearances were obſerved: moreover, they loſt immediately and entirely, the mobility of the iris, ſo that the approach of a bright candle, or perfect darkneſs, produced no change in it. See *Tiſſot* des Nerfs. T. i. p. 11. p. 63.

21. So long ago as 1756, I made the following experiments, as well as ſeveral others, which I have formerly noticed.

Having opened the abdomen and breaſt of a kitten, only two days old, I cut out the heart, which continued its ſyſtole and diaſtole in a very lively and regular manner, and, in that ſtate, put it into a tea-cup containing ſome laudanum: in that moment the pulſations of the heart ceaſed, and could not be renewed again with warm water, or any kind of ſtimulus. The ſame event happened to a piece of the inteſtine, cut out, when dipped in laudanum: the periſtaltic motions, which were briſk before, ceaſed inſtantly, and could not be renewed by ſtimuli. I repeated theſe experiments in another kitten, three weeks older. Having divided the heart in two pieces, out of the body, one of them was thrown into laudanum, a little diluted with water, which in a very little time loſt its pulſatory motions, and ſtimuli had no power or effect in reſtoring them: but the other half of the heart, lying at the ſame time upon the table, contracted very briſkly whenever it was touched with the point of a needle, or a knife,

and

and that long after the other half, ſteeped in diluted laudanum, remained immoveable. Laudanum put a ſpeedy end to the periſtaltic motions of a piece of inteſtine, taken from this kitten, as from the former one: yet another piece of the ſmall gut, cut out, lying on the table, continued to move and twiſt itſelf with great vivacity, when it was ſtimulated. So ſtrong is the principle of irritability, and of life, in ſuch young animals; and ſo certain is the power of opium, in putting a ſudden end to it. I very lately dropped ſeveral ſnails into a mixture of laudanum and water: far from reſtleſſneſs, or other ſign of ſtimulus from the action of the mixture, the reverſe appeared: they never ſtirred, lay motionleſs, and ſlept, in a few hours, the ſleep of death.

Mr. *Y*——, of the age of fifty years, took by miſtake at bed-time, about ten drachms of laudanum: he had a fit of gout at the time. No alarm was given till about four or five o'clock next morning, when exceſſive drowſineſs and languor came on: after that he took repeated doſes of tart. emet. by which ſome of the laudanum was rejected by vomiting.

I ſaw him about nine the ſame morning: his paleneſs, languor, and lethargic diſpoſition, were very great; his pulſe beat languidly, about thirty-eight ſtrokes in a minute. By ſtimulating his throat with a volatile embrocation, he was impowered to ſwallow, (for that function was much impaired,) a ſtimulating cathartic: bliſters were applied to the back and arms; and ſinapiſms to his feet. He took, by my direction, coffee frequently, and after each doſe of it, a deſert ſpoonful of vinegar. He was alſo carried out, and well ſhaken in a poſt-chaiſe on a rough road. About four o'clock in the afternoon, he was ſo much rouſed, that his pulſe beat at leaſt ſeventy ſtrokes in a minute: I now thought him ſafe. The dangerous ſedative power of this enormous doſe of opium was thus obviated, and his brain put into ſuch a ſtate of vigilance, that the enſuing evening, he ſpent a reſtleſs night. He enjoys ſince, and at this time, a tolerable ſtate of health.

When I have taken opium for a tooth-ache, the diffuſed uneaſineſs is firſt removed by it, after that the pain in the tooth and gum ceaſe, and reſt ſupervenes, at leaſt for ſome time: this is a ſpecimen of the general way opium gives eaſe, in caſes of leſs and greater importance.

23. Theſe facts ſhew that the power of the nerves, throughout the whole ſyſtem, is deſtroyed, by the action of opium on the nerves to which it is applied; and, that the moſt diſtant nerves, almoſt

moſt inſtantaneouſly, ſubmit to its power, certainly long before it can be received into the blood veſſels, or be conveyed by them to the remote parts of the ſyſtem: and, in frogs, we ſee it ſuddenly takes away every appearance of life, after the heart is taken out. I do not ſay how it acts ſo extenſively, or by what means it is conveyed; the fact is certain:—and, thus, the nerves in ſome manner, yet unknown, conduct the principle of life, with aſtoniſhing celerity, and afford almoſt as quick an entrance to the inſtruments of death.

But this is not the purpoſe of nature: on the contrary, it is by the ſame ſalutary law, that the refreſhment of food, and healing powers of medicine, are diffuſed over our frame; and, that opium, under ſkilful direction, reſtores eaſe, and preſerves life.

After having been ſo long uſed in medicine, it may ſeem ſurpriſing, that any controverſy, any difference of opinion, concerning the operation of opium, ſhould continue undecided: I do not ſpeak of the more ancient opinions, *whether it is cold in the fourth degree*, according to *Galen*'s followers; or, whether in oppoſition to them, it is not. I now conſider, whether it is *abſolutely a ſtimulant*, or *potentially a ſedative medicine*; or, as ſome think, both a ſtimulant and a ſedative medicine.

24. I believe it will not be denied, that large and poiſonous doſes of opium, are fatal by directly extinguiſhing thoſe vital powers in the nervous ſyſtem, by which they are the inſtruments of ſenſation, and, of every action in the animal œconomy.

The leſſer doſes of opium act, in proportion to the quantity, in a ſimilar manner to the greater doſes, on the nervous ſyſtem; and while the former extinguiſh life, the latter aſſuage pain, and moderate exceſſive and unnatural ſpaſmodic motions, both as palliatives and remedies: and, when judiciouſly applied, with very ſalutary conſequences.

Small doſes lull and benumb ſenſation, and ſuſpend its exerciſe; and, abate both the power and exerciſe of motion: this ſuſpenſe, contributes to the reſtoration of the nervous power, perhaps in the manner it is renewed in ſleep: ſo that animal invigoration in this caſe, is not rouſed or exhauſted by ſtimuli, but, by a remiſſion of action; the proper benefit and effect of this ſedative remedy, when applied with judgment.—Like the power aſcribed to the rod of Mercury, in the Æneid.

—————— hac animas ille evocat orco
Pallentes, alias ſub triſtia Tartara mittit;
Dat ſomnos adimitque, et lumina morte reſignat.

Thus opium, may produce effects, very different and oppoſite, according to the doſe, and the diſeaſe and conſtitution of the patient. When given ſeaſonably, and with diſcernment, the eaſe it gives, is a prelude to the preſervation of life, and the reſtoration of health: in raſh, in unexperienced and unſkilful hands, it is often a ſpeedy paſſport to the grave.

25. From the facts and obſervations enumerated hitherto, from 19—24, it appears that opium acts as a potential *ſedative*, and, *only as a ſedative.*

The ſtimulating matter contained in a grain or two of opium, is very inconſiderable, compared to the ſtimulating power in pepper, and a hundred other ſimples, which have no ſuch effects on animals as opium: ſo that the action of opium cannot be ſimilar, or attributed to ſtimulus.

If at any time it appears to have different powers, they are *ſecondary* effects, ſuch as are conſequences merely of its primary proper ſedative power, acting upon the living ſyſtem in various conditions, of health and diſeaſe.

This medicine having formerly been applied, very pernicioufly, in fevers, and doctrines having been lately promulgated, which threaten a return of ſuch abuſes, I ſhall add a few reflections, the reſult of experience and obſervation, on the uſe and operation of opium.

Externally applied, except in wounds, its effects are ſeldom very conſpicuous. In glyſters, its operation is hardly leſs powerful, than in the ſtomach. When received into the ſtomach, its operation is powerful and extenſive, in conſequence of the ſenſibility and connection, the nerves of that organ have with the brain and heart, and every part of the body.

By rendering us leſs ſenſible to the ſtimulus of ordinary ſenſation, and of pain, the procuring ſleep, is one of its earlieſt conſequences: that is, a temporary ſuſpenſion of the functions of ſenſation and voluntary motion, takes place. In the vital functions, the heart becomes leſs ſenſible to the ſtimulus of the blood: and its motions, and the pulſations of the arteries, with reſpiration, are rendered ſenſibly ſlower, and the pulſes thereby fuller.

Its powers, of leſſening the irritability and activity of the alimentary canal, and, of diminiſhing and ſuſpending every evacuation, that of ſweating alone excepted, are well aſcertained. As it is certain, an encreaſed doſe ends in the extinction of every animal function, it is evident, that the proper operation of opium, whether in ſmall or greater doſes, is uniformly ſedative, and that by this power, health may be reſtored, and life extinguiſhed.

The reſiſtance given by the vital parts, to whatever tends to their extinction, occaſions ſecondary effects, which have been miſtaken for the direct conſequences of the primary powers of opium. This has occaſioned an error, of practical importance, by which a ſtimulating, and *direct* ſtrengthening power, has been attributed to opium, as well as its proper ſedative power. The ſtruggles of the viſ-conſervatrix naturæ, to reſiſt powers, operating towards its extinction, and the convulſions of death itſelf, have been deemed evidences of a ſtimulating power in opium, and of vigour derived from it.

But we maintain, that, opium, in ſome degree, conſtantly weakens and relaxes every animal function; that it benumbs ſenſe, and makes us leſs apt for muſcular exertion; and, that it never beſtows ſtrength, but when, by its ſedative power, it ſuſpends or cures diſeaſes, in which ſpaſms, pains, protracted vigilance, and exceſſive evacution, weaken the ſyſtem. Opium in this manner ſtrengthens, when it puts an end to a nephritic fit, cures a cholic, moderates and checks any exceſſive diſcharge of blood, cures diarrhœa, or gives reſt in the torture of rheumatic and gouty pains.

That the convulſions, and other re-actions which appear in animals, ariſing from leſſer doſes of opium, and other ſedative poiſons, are not the effects of ſtimuli, appear from this: that large and encreaſed doſes of the ſame adminiſtered, inſtantly extinguiſh life, without ſtruggle and reſiſtance.

26. Dr. *Cullen* allows, (Mat. Med.) that narcotics generally weaken the powers of vital motion; yet inconſiſtently aſſerts that opium, in its firſt operation, often irritates the ſanguiferous ſyſtem, and excites the force of circulation. The only colour for this aſſertion, ſeems to be the conflict which takes place, between the natural and morbid ſtimuli acting on irritable organs, and the ſedative power of doſes of opium, inſufficient to quiet theſe irritations altogether. The fact is this, the forces of the heart are weakened, and the circulation of the blood retarded, by the ſedative power of opium, if the doſe be ſufficiently powerful. If ſmall and inadequate, the effect may be imperceptible; but it would be abſurd to alledge, ſuch doſes create powers, they are unable to ſuppreſs.

It has been ſaid the ſtimulant, as well as ſedative power of opium, is manifeſted by ſome of its preparations, proving powerfully ſudorific: not to mention the powerful ſtimuli added to opium in *Theriaca* and *Dover*'s powder, and other compoſitions. Sweating is generally cauſed by relaxation of the ſurface of the body: in this operation, opium brings on a ſtate, in ſome reſpects, analogous to the ſweating, which in relaxed conſtitutions takes place during ſleep, the effect of debility, and, as in hectic diſeaſes, of colliquation.

In a word, the operation of ſmall and ſalutary doſes of opium, *is ever potentially ſedative*, and exactly ſimilar to that by which, in poiſonous doſes, it is known to deſtroy irritability, and extinguiſh life.

27. Dr. *Cullen*'s ideas of the operation of this medicine, appear to me contrary to experience.

" We are diſpoſed to think, ſays he, that all continued fevers ariſe from contagion, or from certain corruptions of human effluvia proving contagious; and it is highly probable that theſe contagions, or matters ſimilar to them, act *as ſedative powers*, and applied to the human body, produce debility, which both induces a fever, and ſubſiſts during the whole courſe of it. In this view of the matter, *opium as a ſtimulant*, to the heart and arteries, may be conſidered as a principal remedy in fevers; and *as ſuch*, we are diſpoſed, with the moſt part of our preſent practitioners, to conſider it. But that it is *univerſally ſuch*, and in every circumſtance of fever proper, we are far from thinking."

In the general view of narcotics, the Doctor, had properly conſidered their powers as *univerſally debilitating and ſedative*: how then can opium, one of the ſtrongeſt ſedatives, and, of the narcotics, be conſidered, in its primary operation, as a ſtimulant to the heart and arteries? This concluſion is one of the inſtances which ſhows how little the rules of induction have been attended to by phyſicians, in this inſtance at leaſt.

Sydenham's method of giving opium in fevers, and ſome other diſeaſes, deſerves the particular attention of young practitioners.

In the decline of fevers, when the return of ſtrength has been prevented by reſtleſſneſs, and a watchful ſtate of the brain, a gentle anodyne is often uſeful; not becauſe it is a ſtimulant, but, on the contrary, becauſe its ſedative power removes inquietude, and induces ſleep, that great reſtorer of animal powers. Hence, though it operates primarily, as a potential ſedative in the ſyſtem, the ſleep procured by it, in a ſecondary way, renders it a reſtorer of health.

In phrenitide, pront febris depuratoriæ ſymptomate, poſtquam venæ ſectiones liberaliores, refrigerantia aſſumpta, et clyſtera; donec in diuturnitatem aliquam affectus excurrat, quo tempore non admodum difficile erit cum et a morbo et a ſymptomate, una eadem opera liberare: id quod fiet narcoticum aliquod medicamentum in largiori paulo doſi exhibendo.———*Narcotica in principio, augmento, vel ſtatu hujus febris, ad ſymptoma hoc levandum, vel non prodeſſe, vel ſæpius obeſſe, tamen opportune et in declinatione morbi adhibita, præclaros effectus edunt, nec citius die morbi duodecimo proſpere exhibitum novi. Sydenham.*

I make this remark the rather, as I find the giving of opium, almoſt in every ſtate, the beginning, and increaſe not excepted, and, every kind of continual fever, has in ſome places become a faſhionable routine, upon *Brunonian* principles. I have obſerved, where this faſhion has prevailed, fevers are oftner fatal than they uſed to be, in the ſame circumſtances and ſituations.

From the premature and injudicious adminiſtration of opium, neceſſary and ſalutary evacuation by ſtool is prevented: bilious and putrid fæces, with putrid air, diſtend and inflate the inteſtines. The tongue becomes dry and foul; a kind of comatoſe ſtate, a fatuitous delirium, and immenſe debility, ſucceed, under which, the patient ſooner or later ſinks. Fevers not only end fatally in individual patients, but the contagion is kept up, and ſpreads in the circle, where they are thus treated: and, the recovery of ſuch as emerge, is unuſually ſlow, tedious, and uncertain.

Nevertheleſs, opium may be of ſervice in fevers of various kinds, in particular circumſtances of irritation: but the occaſion is beſt learnt by obſervation and experience.

As I know that opiates ſuppreſs evacuations by ſtool, I ſeldom order any in the beginning of fever, unleſs to give quiet after the operation of an emetic, or to moderate evacuation by ſtool, when it is exceſſive, or ariſes from too much irritability.

In a word, if any ſymptom in the acme of fever, or in its decline, requires a ſedative medicine, I ſhall, on ſuch occaſions, adminiſter opium in cautious doſes. If a ſtimulus is needed, or a ſtrengthening medicine, properly ſo called, I ſhall not for that purpoſe adminiſter opium.

Wine, in ſuch circumſtances, is the beſt ſtimulant and cordial; and Peruvian bark, with proper antiſeptic aliment, the beſt reſtorer and ſupporter of ſtrength. — I am not here writing a treatiſe on fevers, otherwiſe camphor, cantharides, and others, would not have been omitted. — The ſedative power in wine, bears a very ſmall proportion to its ſtimulating energy: and, like the ſtimulating matter and power in opium, is ſo inconſiderable, as ſcarcely to deſerve conſideration, and to be below eſtimation. The excitement of the languid powers of nature, and of the nerves in low fevers, by a *diſcreet uſe of wine*, makes it highly ſalutary, both as an antiſeptic and ſtimulating medicine.

28. It cannot, however, be forgot, that opium, is one of the great and important inſtruments of the healing art, relieves pain, and gives ſolace to the tortured body and mind. It gives more than relief in cholic, cholera, and in nephritic excruciating paroxyſms: it is uſeful in the ſmall-pox, and ſome other eruptive fevers; it ſtops or ſuſpends hæmorrhages, gives eaſe in rheumatic, venereal, and many other painful diſeaſes, which afflict mankind.——But the miſchief of the alexipharmic treatment of fevers, in which compoſitions containing opium, indiſcriminately uſed, were ſo injurious, that I thought every veſtige of that method had forever been exploded; and makes me

fear and ſuſpect, renewed calamity, from this reſtoration of a method, ſomewhat reſembling it: for the miſchiefs of that method, did not conſiſt altogether in the foul air of a cloſe hot room, and in a vaſt load of bed-cloaths; but, in the early and promiſcous adminiſtration of compoſitions, in which opium was the predominant, and the moſt pernicious ingredient.

But ever attentive to juſt information, as well as to ſound obſervation, I ſhall continue to uſe this remedy as a great medical reſource; believing with *Sydenham*, "Ita neceſſarium eſt opium, in hominis periti manu, organum, ut ſine illo manca ſit et claudicet medicina; qui vero eodem inſtructus fuerit, majora præſtabit, quam quis ab uno remedio facile ſperaverit."*

I have dwelt the longer on the operation of opium, not merely becauſe I think it miſapprehended, but alſo becauſe it manifeſts, in a clear manner, the extent of the law of ſympathy.

This makes it the leſs neceſſary to enumerate all the phænomena of ſympathy: thoſe who de-

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* Opiates, by benumbing the ſenſes, and in large doſes diſordering them, ſuppreſs thoſe ſenſations, which ſhow the real ſtate of diſeaſes; and thus delude the patient, and often deceive the phyſician, with falſe appearances of relief.

ſire farther ſatisfaction, will find a great deal, in the excellent works of Dr. *Whytt* and Dr. *Tiſſot*, already quoted.

29. From the univerſal communication of the nerves with the great ſympathetic, the eighth pair, and the brain, ariſes the ſympathy of the head and ſtomach, and of the thorax with the viſcera of the abdomen, and their liableneſs to be affected with paſſions: on the other hand, by a kind of retrograde ſympathy, the mind is ſedate or agitated, exhilarated or depreſſed, according as theſe viſcera are affected in health and diſeaſe.

The affections of the mind, impreſſed upon the features by the medium of the nerves of the fifth and ſixth pairs, diſplay, in the eyes and muſcles of the face, thoſe phyſiognomonic characters, which diſtinctly mark every paſſion, and each emotion of the mind, in ſo evident a manner, as to connect or diſunite mankind; ſo as to inform, or create attachments, or excite averſions to one another, by a natural utterance, prior to, and more expreſſive than language, and artificial characters: from the former, domeſtic animals diſtinguiſh the diſpoſitions of perſons with whom they live, and on whom they depend.

The ſcience of phyſiognomy, carried to ſuch whimſical lengths by the ingenious *Lavater*, has much foundation in nature: it is doubtleſs ſubject to uncertainty, and muſt vary according to the experience and ſagacity of the obſerver; and the theories of this obſerver, perhaps, often give a ſuſpicious bias to his inferences.

In the action of ſneezing, the diaphragm is made to contract, by the irritation of the membrane of the noſtrils. A ſudden tickling of the ribs, and of the ſoles of the feet, cauſe involuntary and painful laughter, that kind of emotion which has been deemed a characteriſtic of man, and, is ordinarily excited by ſudden and unexpected combinations of pleaſant ideas and impreſſions, upon the mind.

From the ganglions of the ſplanchnic nerves being affected, as other nerves often are, and, as theſe may be, much oftner than we are aware of, by acrimony, irritation and inflammation; wounds, or ſome other morbid cauſe, *C. Piſo*, *Willis*, *Bohn*, and others, derive the ſource of painful cholics.

30. *M. Senac* juſtly obſerves, that in wounds of the viſcera, viz. the liver, ſtomach, meſentery, inteſtines, ſtrangulations, and ſevere cholics, the pulſe is always uncommonly ſunk and concentrated, and the force of the heart ſignally diminiſhed:

niſhed: this is the conſequence of every ſpecies of ſympathy. In order to account for theſe effects, ſo frequent above all others in affections of the abdominal viſcera, this ingenious writer, to whom the uſes of the ganglions were unknown, was led to conjecture, that theſe parts had proper ſympathetic nerves diſtributed to them, independent, and different from other nerves; and theſe he ſuppoſed to be the ſeat of ſuch frequent ſympathetic affections: the obſervation ſeems to juſtify our ſuppoſing, that he would not have failed to have referred that ſympathy to the ganglions of thoſe nerves, had the uſes thereof been known to him.

The parts on which the ſplanchnic nerves are diſtributed, and thoſe connected with them, eminently ſuffer, in hyſterical and hypochondriacal complaints. In cholics from lead, and every other cauſe, and in the cholera morbus, the limbs are often ſeverely cramped and convulſed; and they are ſomtimes left in a paralytic ſtate, by diſeaſes primarily ſeated in the bowels, more eſpecially in lead cholics, which are very frequent in ſeaſons when cyder is in plenty.

A perſon of the age of fifty years, lately conſulted me for ſuch a diſeaſe, left by a ſevere cholic; which came by drinking cyder plentifully, (as uſual in Herefordſhire,) which was made at a mill mended with lead. He had very little power in his arms, his limbs were much extenuated, as well as paralytic. He received ſufficient ſtrength in them by tinct. ſacræ, and tinct. guaiac. volat. drach. ii.—bis die. taken only for a week.

This is one of the many inſtances of the power of the poiſon of lead, acting backwards, from the great ſympathetic nerves, to the voluntary nerves and muſcles, and the effect is not uncommon.

When the mind is affected in ſudden paſſion, the heart palpitates, and the diaphragm is irritated into quicker movements: the velocity of the blood is thus accelerated, the pulſe and reſpiration quickened, from this and various other cauſes, acting in the ſtomach:—hence ariſe aſthmatic paroxyſms, which are often relieved by bliſters, and other epiſpaſtics, applied to the back; becauſe reſpiration is in part carried on by the dorſal nerves, which are connected with the intercoſtals.

31. As the viſcera in the abdomen are all connected in the cloſeſt ſympathy, by deriving their nerves from the great ſolar meſenteric ganglion, called by *Wriſberg*, cerebrum abdominale,—hence it ariſes, that a ſtone, deſcending from the kidneys by the ureters, diffuſes ſevere pain in every part of the bowels, whence it is often miſtaken for a com-

mon cholic.—Hence vomiting is excited by the paſſage of gall-ſtones into the duodenum:—and hence the ſevere action of emetics, cauſe bile to be thrown back into the ſtomach from the duodenum, and to be thrown up in the laſt ſtrainings, in the operation of an emetic.—The vomiting ſometimes excited by a violent and cruel irritation from calculus in the urinary bladder, as well as during its deſcent in the ureters, and from pains in parturition, or from inflammation of the uterus in puerperal fevers, is a very dangerous ſymptom.

Moreover, as the lower meſenteric plexus, ſends nerves to the male and female organs of generation, to the rectum and urinary bladder, and to the membranes and vertebræ of the loins: and theſe afterwards communicate with the nerves deſcending to the limbs: from this univerſal communication it happens, that diſeaſes in the bowels often affect the organs of generation with painful ſpaſms: and that pains are reciprocally excited in the back and inteſtines, by inflammatory tumours in the teſtes, and other organs of generation: and that teneſmus and irritation in the rectum, are accompanied with painful motions to empty the bladder, and vice verſa. Finally, that calculi in the bladder ſhall not only cauſe uneaſy itching in the glans penis, but likewiſe itching, and often violent pain, in the feet, with tremor and horrors over the whole body.

The irritations from cancerous acrimony ſeated in any part, are as cruel as they are extenſive. A lady afflicted with a cancerous uterus, originally complained of pains in the ſtomach and bowels: and at the ſame time was often troubled with frequent returns of ſevere cramps in her legs. She now complains of violent pains in the courſe of the nerves, and veſſels under the joint of the right knee. Her inquietude, and uneaſy ſenſations in her back, ſhoulders, and breaſt, are ſo great, that every thing that touches her gives her pain. Her pulſe is low, quick, and unequal. Her reſpirations difficult, without cough; and on attempting to move, her pulſe flutters as if ſhe was expiring. The os uteri is hard, ſcabrous, and unequal; and from that part are diffuſed thoſe irritations, which are ſoon to terminate in death, and which in the mean time make life miſerable.——The event happened a few months after, as here foretold.

I have done with the particulars of ſympathy; and have only to to add,—As the removal of pain by opium, and the refreſhment of the ſyſtem by wine and food, are ſoon communicated from the nerves of the ſtomach to every part: thus alſo, frequent returns of painful and ſpaſmodic diſeaſes, act from a part of the nervous ſyſtem to the whole, and often eſtabliſh a diſeaſed habit; and pain and diſeaſe in any part, occaſions them to be felt at a diſtance, ſo that the part originally acted upon, ſhall often appear leſs affected, than that which ſuffers by nervous communication and ſympathy.

32. Dr. *Willis* and *Vieuſſens*, deſcribe the uſes and functions of particular nerves, with great propriety: and it has been obſerved by the late Mr. *John Hunter*: (and I name him, to expreſs my eſteem; and my regret, for the loſs phyſiological ſcience has ſuſtained, of one who purſued that part of knowledge, with uncommon diligence.) He obſerved, " that the origin and number of nerves, being invariably deſtined for particular parts, he is perſuaded, this general uniformity, in courſe, connection, and diſtribution, anſwers ſome purpoſe, ſuperior to mere mechanical convenience. Many variations, deſcribed in the diſſections of nerves, he believes, have ariſen from the blunders of the anatomiſt, rather than from any irregularity in their number, mode of ramifying, courſe, diſtribution, or connection with each other." He adds: " I have no doubt if their phyſiology was ſufficiently known, *we ſhould find the diſtribution*, and, *complication of nerves, ſo immediately connected with their*

their particular uſes, as readily to explain many of thoſe peculiarities, for which it is now difficult to account." (Obſ. on the Animal Œconomy, p. 213.)

This is what I have attempted in the former Eſſay on the uſes of the Ganglions of the Nerves, and in this additional illuſtration and application of the truths maintained in it; with what ſucceſs, the preſent and future age will judge and determine.

III.

Caſe of Angina Pectoris, *from an unexpected diſeaſe in the heart. By* James Johnſtone, M. D. C. M. S. *&c.—Firſt publiſhed in Memoirs of the Medical Society, London.—Vol.* i. *Art.* 22.

Read December 17, 1786.

THE Reverend *Gregory Parry*, prebendary of Worceſter, &c. ſomewhat under the middle ſize, with a ſhort neck, and inclined to corpulence, of a cheerful and ſocial temper, had enjoyed very good health till after his ſixtieth year; it was ſome time after this, that the extracting the chryſtaline humour, which became cataractous and opaque in both eyes, was performed by Baron *Wenzel*, ſo as to ſecure him the ſight of one eye to the laſt. He found the ſenſation during the operation, like an uneaſy tickling, rather than pain, properly ſo called, and went through it with ſpirit.

He conſulted me in the ſummer of 1783, for a pain in his ſtomach, which ſeeming to be only flatulent, and to ariſe from indigeſtion, eaſily yielded to draughts of the warm ſtomachic kind, with *tinctura ſacra*; returns of ſuch uneaſy feelings in the ſtomach, were not unuſual, nor unfrequent after this, but always yielded to the uſe of theſe draughts. He had, at this time, a pulſe remarkably ſlow, though very regular, which made me intimate to his family, conſidering his make and age, the propriety of precautions, if any thing like giddineſs, or pain in the head, ſhould appear to threaten apoplexy. Nothing, however, of this kind happened; and no appearance of ſymptom ſuggeſted his having the *Angina Pectoris*, till after his return from a viſit to London.

In June laſt, he complained of ſhortneſs in breathing, with pain in his cheſt and acroſs his arms, on walking, eſpecially up any aſcent; and, of ſuch complaints he had frequent returns, in the months of June and July, notwithſtanding bleeding, a briſk cathartic or two, and ſome other medicines were ordered, beſides the repetition of the ſtomachic draught, of which he had a good opinion, from the relief he had received from it: and now, I plainly ſaw he was affected with a diſeaſe, which has proved ſo conſtantly fatal, and expected, ſooner or later, to hear of the ſad event.

Juſt before he left Worceſter, he had a ſhort and ſlight fit of the gout, which ſeemed to relieve him, and gave me ſome encouraging hope: indeed, he remained free from this complaint till he had been in Wales; but a ſhort time afterwards, the fatal ſymptons returned, more than once, previous to the attack, which ſuddenly ended in death.

That evening, the 2d of Auguſt laſt, he ſeemed cheerful and well; but after being ſome time in bed, he complained he was very ill, and ſat upright in it; but after his *tinctura ſacra* draught, he ſeemed eaſier, and Mrs. *Parry* heard no more complaint till ſome time afterwards.

Early in the morning of the 3d of Auguſt, ſhe was rouſed by the noiſe of his expiring groan: in fact, he was dead in an inſtant; and, I believe, had entered the ſeventy-firſt year of his age.

His body being opened the 4th of Auguſt, by Mr. *Gunter*, ſurgeon, in Brecon, the following is a very ſenſible account of what he obſerved, which I give in his own words.

" Sir,

" At the deſire of Mrs. *Parry*, I beg leave to inform you of the appearances attending the diſſection of the late Mr. *Parry*. The inteſtines were in a natural ſtate, but much inflated with wind; ſtomach covered with a very black mucus, quite empty, very much diſcouloured, in many places black, particularly about the *pylorus*; the blood-veſſels over it very much diſtended; the liver indurated in every part, but moſtly ſo about its edges; the heart very putrid, admitting my fingers paſſing through it with very little preſſure, it was quite empty, and the veſſels going to and from it, perfectly ſound, and no oſſification; the lungs ſound, not even an adheſion; the *pancreas* ſomewhat hardened; kidneys very much diſeaſed, hardened in every part; the *pelvis* with difficulty diſtinguiſhed, it was covered very much with fat, highly tinged with bile:—theſe are the whole appearances.—He was not my patient, otherwiſe I ſhould have examined the head; but the gentleman under whoſe care he was, did not chuſe it: from the diſſection, perhaps, it may be difficult to aſſign the immediate cauſe of death. If the above account can contribute to throw any light, or give you ſome ſatisfaction, I ſhall think myſelf happy in ſending it; and am,

your moſt humble Servant,

W. Gunter."

Brecon, *Oct*. 2, 1785.

This diſſection ſhews another almoſt unſuſpected cauſe of ſudden death.—This gentleman laboured under, firſt, the complaints of indigeſtion, a flatulent pain, with which he had been long troubled, before any ſymptoms of *Angina Pectoris* were heard of; to ſuch complaints the diſordered ſtomach, the diſcoloured *pylorus*, inflated inteſtines, and even hardened liver, (he had no icteric colour,) have an obvious and cloſe connection.

Secondly.—The ſymptoms of *Angina Pectoris*, which troubled our patient in the laſt three months of his life, plainly aroſe from, and were ſymptoms of, defect of power in the heart. From what cauſes, or cauſe, the putridity, or diſpoſition to mortification, which ſeized this vital muſcle, aroſe, may not be very clear; but that ſuch a ſtate muſt render it unfit for its office of carrying on the circulation of the blood, or, in other words, of ſupporting life, muſt be evident.

The heart being inſenſible, even its diſeaſes are attended with no proper ſenſe of pain, peculiarly felt at this part; a thouſand experiments, as well as accidents and caſes, have eſtabliſhed this fact: but that peculiar ſenſation of weight and agony, with difficult breathing, and, pains extending to the arms, and pectoral muſcles, on attempting to move; in ſhort, a ſenſe of failing life, when the heart, from any diſeaſe affecting its mechaniſm, and diſturbing its motions, is hindered in diſtributing or propelling the blood, through the pulmonary artery and lungs, into the left ventricle of the heart, and from thence into the aorta and the whole body, ſeem to be the ſymptoms of danger in this organ. It is in this ſtate ſo immediately threatening to life, in this convulſive, agonizing ſtruggle for exiſtence, that the cardiac nerves, derived from the thoracic ganglions of the great ſympathetic nerves, are ſtimulated in an extraordinary manner indeed, and that all the wide-extended connections of the ſympathetic nerves, particularly thoſe in the cheſt and ſuperior extremities, are irritated thereby into painful ſpaſms, ſuch as are felt in the *Angina Pectoris*, though leaſt of all felt, in the organ from whence they originate, the heart itſelf.

I think it quite unneceſſary here to ſhew, from approved anatomical works, that the cardiac nerves have the origin and connections here taken for granted. I ſuppoſe my readers neither to be ignorant nor captious. My learned friend, the late Dr. *Wall*, reaſons in the ſame manner. See *Med. Tranſ.* vol. iii. alſo, *Lanciſi de motu cordis & aneuriſmatibus*, *Vieuſſens neurographia*, and the tables of *Walther* on the *Viſceral Nerves*.

But inteneration of the heart from putridity, ſometimes has been the occaſioning cauſe of ſudden death, by rendering the ventricles of the heart liable to rupture: of this accident our late ſovereign *George* II. died at an advanced age; and in a Memoire, by *M. Morand*, in the Memoires de l'Academie des Sciences de l'an 1732, concerning remarkable accidents in the organs which carry on the circulation of the blood, he mentions the caſe of the Dutcheſs of Brunſwick, who died of a rupture of the right ventricle of the heart, in 1730; and that of a perſon of condition, examined by himſelf, who died the ſame year, of a rupture of the left ventricle of the heart: and he adds, "Pour
" expliquer comment, dans les deux cas que j'ai
" rapportes les ventricules du cœur ont pu ſ'ouvrir
" ſans cauſe exterieure, il faut remarquer que dans
" le premier, il y avoit une eroſion aux fibres char-
" nues du ventricule droit, qui ſembloient avoir ete
" ulcerees & creuſees peu a peu juſqu' au trou qui
" ouvroit le ventricule; et que dans le ſecond, le
" chair du cœur etoit devenu molle au point qu'
" en quelque endroit qu' on preſentat le bout d'un
" ſonde, ſans l'appuyer, elle entroit & traverſoit le
" cœur par le ſimple poids, de l'inſtrument qui
" n'eſt pas conſiderable.

" Donc la rupture de cet organe ſera raiſonna-
" blement attribuee a l'amolliſſement de ſes fibres
" ou

" ou a un ulcere qui en aura uſe' l'epaiſſeur. On " trouve pluſieurs examples de l'ulcere, dans le " Recueil de Bonetus, mais un ſeul de la Mo" leſſe."

The enlarged bulk and weight of the ſubſtance of the heart, is ſometimes ſuddenly fatal, as well as its rupture: ſuch a caſe is quoted by *Lanciſi*, from the Chirurg. Obſerv. of *P. Marchetti*. The patient ſeems to have laboured under the ſymptoms of the *Angina Pectoris*, as they are exactly and eloquently deſcribed by Dr. *Heberden*. The heart was found three times its natural ſize, and the pericardium adhered in many places to the pleura, and even to the diaphragm, ſo as to weigh it down, and occaſion a fulneſs in the hypochondria.

A corpulent gentleman, aged ſeventy, who had been for ſome time troubled with aſthma and pain in his cheſt, and died ſuddenly, being opened, oſſifications were found in the aorta, and the baſis of the heart; its bulk and weight increaſed by an unuſual quantity of fat: ſuch alſo ſeemed to be the cauſe of the ſudden death of *C. B*——; for the heart and abdomen ſeemed covered with more fat than Mr. *Cauſer*, a ſkilful ſurgeon, who opened the body, had ever ſeen.

Beſides theſe cauſes of *Angina Pectoris*, oſſifications of the valves of the heart, polypoſe concretions in its ventricles, extending far into the great veſſels; water, blood, and purulent matter in the pericardium, mediaſtinum, or cavity of the thorax, have produced it: and the ſame ſudden termination of life, will often be brought about by cauſes acting on the living nerves, which leave no morbid appearance in the vital organs, diſtinguiſhable after death by diſſection.

Aneuriſms, ruptures, and other fatal diſeaſes of the heart, are often cauſed by fear, ſudden paſſion, oppreſſive anxiety, and other vehement emotions of the mind, often indulged. I recollect ſeveral perſons who had the *Angina Pectoris*, and who died ſuddenly, to have been of this kind of diſpoſition. The government of paſſion is, therefore, to be conſidered as neceſſary to prevent this cataſtrophe, as well as to ſecure general eaſe and health. Far be it from me, to wiſh to baniſh from the breaſt its moſt engaging feelings, and to plant inſtead, the unfeeling torpor which inſulates individuals, and makes them unaffected and indifferent to the intereſts, the woe, or happineſs of mankind. Such was not my deceaſed friend. I only wiſh to regulate, and temper this amiable warmth of ſoul, and to keep in view a fact, that the heart is an involuntary organ. Volition has no power over it, and unimpaſſioned thought does not affect it; but the frequent repetition and long indulgence, in vehement and uneaſy paſſions, have often created the moſt fatal diſeaſes in this part.

This ſurvey of ſome of the cauſes of *Angina Pectoris*, ſhews why it is ſo generally an incurable and mortal diſeaſe, and yet points out the expediency of attempting a cure, in ſome caſes and circumſtances; and, in all caſes, the duty of attempting to put off the fatal hour, by prudent methods of prevention and palliation, by ſobriety, and regularity of life and diet, guarding againſt exceſſes of every kind, which may create indigeſtion, or too much diſtend the ſtomach, eſpecially at bed-time; for in a decumbent poſture, the preſſure of a ſtomach over-filled, as well as its uneaſy, irritated ſtate, muſt create very dangerous obſtacles to the circulation of the blood, when any diſeaſe in the heart renders it already too unequal to its office; obviating fulneſs of the blood-veſſels, by ſeaſonable evacuations, and by keeping the ſecretions open: avoiding hurry, and exceſſive accelerated motion, by hard exerciſe; yet ſupporting the ſtrength and ſpirits, by being much in the open air, and on horſeback, and much too in the ſociety of cheerful and eaſy companions.

Worceſter, Dec. 1, 1785.

IV.

An Account of two extraordinary Caſes of GALL-STONES. *By* James Johnſtone, M. D. *of Kidderminſter.* —— *Communicated by the Rev.* Chares Lyttelton, L. L. D. *Dean of Exeter.*— *Firſt publiſhed in Phil. Tranſ.—Vol.* l. *p.* ii. *p.* 543.—1758.

Read February 9, 1758.

To the Rev. Dr. Lyttelton, *Dean of Exeter.*

Rev. Sir,

ACCORDING to my promiſe, I ſend you a ſhort account of the two extraordinary caſes we talked of, the laſt time I had the pleaſure of ſeeing you at Kidderminſter.

The truth of the firſt narrated caſe, you are already

ready a ſufficient judge of; and if it is at all neceſſary to aſcertain the ſecond in like manner, I can, at any time, produce the poor woman and her huſband before you, who will atteſt the truth of ſufferings, which will not eaſily eſcape their memory.

You are at liberty to diſpoſe of this paper as you ſhall think proper. I am,

Reverend Sir,

Your reſpectful and moſt humble Servant,

J. Johnstone.

Kidderminſter, *Sept.* 11, 1757.

THOUGH it is now pretty well known, that cholicky and icteric diſeaſes, often ariſe from gall-ſtones, generated in the bilious receptacle, and obſtructing its canals; yet an example of one, of ſuch enormous ſize, voided into the *duodenum*, from the *ductus communis*, as happened in the firſt of the following caſes, is very rare, if not entirely an unexampled occurrence. It will encourage us not too eaſily to deſpair of the expulſion of the largeſt *calculi* from the gall-bladder; and will teach us, that all violent attacks of pain about the ſtomach, are not owing to gout reflected upon that organ: it will make us more cautious of giving draſtic cathartics, heating and inflaming medicines, upon ſuch a vague preſumption; and ought to diſpoſe thoſe, who are truſted with the lives of their fellow-creatures, to a nicer obſervation, of even the minuteſt ſymptoms and circumſtances, which may occur in diſeaſes.

The ſecond caſe points out, under certain circumſtances, the practicability of extracting, by inciſion into the gall-bladder itſelf, thoſe *calculi*, which, from their figure, or other impediments, cannot be voided in the natural way. The method of performing this unuſual operation, and ſome inſtances of its ſucceſs, have already been made public, in the Memoires de l'Acad. de Chirurg.

1. Mrs. *Floyer*, wife of the late alderman *Floyer*, of Worceſter, a ſedentary, corpulent old lady, had been much ſubject to cholicky complaints, without jaundice, in the vigour of life. The ſeat of the pain was chiefly under the right *hypochondrium*, as high as the ſtomach. She had been tolerably free from it, for at leaſt eight years paſt. December 5, 1753, about eleven o'clock in the evening, ſhe was ſuddenly ſeized with a violent pain, extending

from that part of the ſtomach lying under the right ſide, through to her back. She compared it to a ſword driven in that direction. This pain continued, not only with unremitted violence, but even increaſed, till ſeven o'clock in the morning: all this time ſhe vomited and ſtrained almoſt inceſſantly; but after her ſtomach was emptied of its contents, nothing came up beſides clear ſlime, ſtreaked with blood. About ſeven o'clock in the morning, ſhe felt her pain fall, or move lower, as ſhe expreſſed it, and from that time became remarkably eaſier. Soon after this change, ſhe became extremely ſick, and vomited up, for the firſt time, a prodigious quantity of greeniſh yellow bile. She had not, before this ſeizure, been remarkably coſtive; and in her pain had a free motion to ſtool, with effect; but during the remainder of the (6th) day, had none, though all this time emollient clyſters were injected; and ſhe took regularly, every two hours, a powder of *magneſ. alb. terr. fol. tartar. tart. vitriol. ana ſcrup.* j. *ol. nuc. moſch. gutt.* j. with a draught of the *ſucc. limon. & ſal. abſinth.* But in the middle of the night, and all day, (the 7th,) ſhe had an abundant diſcharge of looſe bilious ſtools. She had continued free from exceſſive pain, ſince the morning of the former day, only now and then complained of uneaſineſs, ſometimes in one, ſometimes in another, part of her bowels. About twenty-four hours after her firſt ſeizure, ſhe felt a great pain ſtriking towards the bottom of her back, and one hour after, voided the extraordinary *calculus*, of which the figure and deſcription are ſubjoined. Some time after, pieces of ſkin were voided by ſtool, which were evidently of the texture and appearance of the internal villous coat of the inteſtines and gall-bladder. The above medicines were the only ones ſhe uſed, by my direction, under her painful complaint, excepting an external fomentation and bleeding, which the hardneſs and contractedneſs of her pulſe ſeemed to require. She was ordered to drink plentifully of thin broths, and other ſoft diluent liquors. During the courſe of her diſorder, ſhe had no appearance of jaundice, nor ſince; and, conſidering her years, enjoys at preſent (Sept. 1757,) very good health.

This *calculus*, as appears by the figure, was of a pyriform ſhape, reſembling the form of the *cyſtis fellea* itſelf. Its ſurface was quite ſmooth and poliſhed, excepting towards the baſe, at that part marked A, where it was ſcabrous, as if ſome other ſubſtance had lain contiguous to it. When broken through, it was compoſed of concentrical laminæ, which were alternately white and ochre-coloured. In length, it meaſured one inch and three-tenths; its tranſverſe ſection meaſured at leaſt ſeven-tenths of an inch. It had a ſaponaceous ſmoothneſs, like other gall-ſtones, and floated upon water. It weighed

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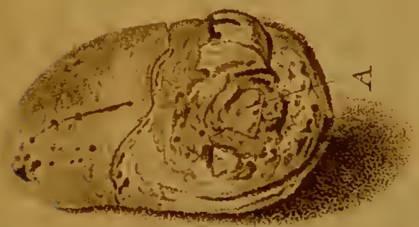
1



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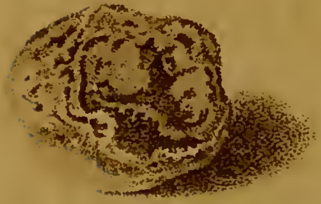
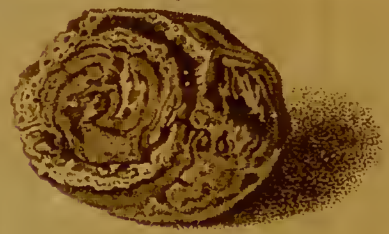


3



[illegible]wel delin.

Roſs sculp.

weighed only about one hundred and twenty-ſix grains.*

Though it be difficult to conceive, how ſo bulky a ſubſtance, generated in the gall-bladder, could be conveyed along ſo narrow a paſſage as the common biliary duct, eſpecially conſidering the obliquity of its inſertion, for near half an inch of length, betwixt the coats of the *duodenum*; yet there ſeems ſufficient *data*, in the above caſe, to prove, that this animal ſtone was not formed in the alimentary tube, but (large as it was) had come into it from the *ductus communis choledochus*.

The ſhape and ſaponaceous ſmoothneſs, and colour of the lamina, of this ſubſtance, ſhew it was moulded in the gall-bladder, and formed from bilious particles. The ſevere pain and torture, and enormous vomiting, ſhe underwent, for ſeven hours after her firſt ſeizure, argue, that it muſt then be lodged in ſome canal, much narrower and ſtraiter than the alimentary canal; for, ſo ſoon as it dropped into that, the ſevere pain, in a great meaſure, ceaſed.

But that ſtrait canal, in which it was ſituated during thoſe ſeven hours of torture, could be no other than the *ductus communis choledochus*; for, during this ſpace of time, no bile was emptied into the bowels, nor thrown up by the ſtrongeſt efforts of vomiting: but no ſooner had ſhe perceived the cauſe of her pain to move or drop downwards, (a ſenſation, which points out the preciſe moment when the ſtone muſt have dropped into the *duodenum*,) than ſhe began to ſicken, and inſtantly after vomited up a large quantity of bilious matter, which now, from the de-obſtructed duct, began to flow freely into the *duodenum*. The obſtruction of the *ductus choledochus* was of too ſhort a duration, (only ſeven hours,) to occaſion any obſervable jaundice. And it appears by the bloody fleſh-like knots, thrown up with phlegm, by vomiting, that the paſſage of the ſubſtance was not effected without conſiderable laceration of the ſmall bilious ducts. And this eaſily accounts for the ſeparation of the villous coat, which afterwards appeared in this patient's ſtools.

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* Figure 1. ſhews the ſize of the entire ſtone—2 and 3, its variegated laminated appearance when broken in two pieces.

The annexed delineation repreſents the figure and true bulk of the *calculus*.—See plate, 1,—2,—3.

2. In February, 1752, I was called to relieve a poor woman of this place, *Sarah Ewdall*, aged thirty years and upwards, and the mother of ſeveral children. She laboured under the jaundice, and complained of a ſevere, acute pain, ſtriking

through from the right *hypochondrium* to her back, with frequent vomitings. A præternatural hardneſs, of a compaſs not exceeding the hollow of the hand, was then plainly to be felt at the pit of the ſtomach, or a little nearer to the right *hypochondrium*. When that particular part was preſſed, ſhe complained of great pain. The pain at this part was always increaſed, by attempting to lie upon the left ſide. She was blooded, fomented externally, had emollient ſaponaceous clyſters injected, and a nitrous apozem, and pills compoſed of *galban. & ſap. Caſtillenſ.* and ſoon after recovered. She had frequent returns of the ſame complaint, after this; but I ſaw her not again till January, 1755, when ſhe lay inſenſible in a fit, which for ſeveral days deprived her of the uſe of her ſpeech, and of all her ſenſes, only ſhe toſſed her limbs about. About a quarter of a year after ſhe had recovered from this fit, Mr. *Cooper*, of this place, her apothecary, informed me, that from a ſmall ſore at the pit of her ſtomach, which came ſince her laſt illneſs, ſhe had voided ſeveral gall-ſtones. Curioſity prompted me to inquire into the matter of fact from herſelf. She ſhewed me the ſore, which was now almoſt cicatrized. She ſaid, that ſoon after her laſt illneſs, a little pimple aroſe upon that part of the pit of the ſtomach, which had been hard ever ſince ſhe had been ſubject to the jaundice. This pimple broke, ran matter, and at different times the *calculi*, which ſhe ſhewed me, had come out with the matter. Her ſtomach had been ſomewhat painful before it broke, but was now eaſy. The *calculi*, which ſhe ſhewed me, had the appearance of being fragments of larger ones, and ſome were almoſt duſt; though ſhe aſſured me, they all came from the ſore in that condition, Of theſe fragments, I have two or three of the largeſt now in my cuſtody: they are light, ſwim on water, ſmooth like ſoap; are of a yellow colour, and in ſome parts brown, like ſnuff; and conſiſt of ſimilar concentrical layers. The poor woman has, ſince then, been troubled with returns of pain and jaundice, in the intervals of which, her ſkin is perfectly clear and white. She is ſtill alive, and ready to atteſt the truth of this narrative.

J. JOHNSTONE.

Kidderminſter, Sept. 11, 1757.

This woman died in 1763, of what diſorder I know not, as I did not afterwards attend her.

V.

Hiſtory of a Fœtus born with a very imperfect Brain.

By James Johnſtone, M. D.—*Firſt publiſhed in Phil. Tranſ.*—*Vol.* lvii. *p.* i. *p.* 118.—1767.

Read March 5, 1767.

IN October 27, 1765, a monſtrous birth was brought me by a midwife of this place. It was a female child, come to its full time, in which the whole ſcull, excepting its baſis, was wanting: this was covered with ſomething which had the appearance of red fleſh. I found it to conſiſt of different membranes; and in a ſmall depreſſion, in a back part of the baſis of the ſcull, lay the brain, ſuch as it was, not exceeding the ſize of the kernel of a filberd nut, flaccid and membranous. I could not have poſitively pronounced it brain, had I not traced its continuation into ſpinal marrow, down the channel of the vertebræ. The eyes were perfect and ſound. The optic nerve of one eye I examined, though not large enough, yet in thickneſs was almoſt equal to one-third of the ſpinal marrow, which was too ſmall likewiſe.

Upon opening the breaſt and abdomen, all the organs contained therein, ſeemed in ſtructure perfect, properly ſituated, and full grown. The heart in particular, was plump and ſtrong. This infant had not breathed; its lungs, which were perfect, ſunk in water: yet the mother and midwife, felt it active and ſtrong, juſt before delivery.

This child had tongue, noſtrils, eyes, and ears, and every other part, excepting the brain, perfect and plump, as in the healthieſt infants, come to their full time.

Many births ſimilar to this, in moſt circumſtances, are recorded in the Tranſactions of the Royal Society, No. 99, 226, 228, 242.

1. Such of them as were born alive, died ſoon after birth, though lively and ſtrong in the womb. And perfect in all parts, the brain and ſcull excepted.

2. In that of which an account is given by Dr. *Preſton*, (Philoſ. Tranſ. No. 226,) the celebrated

anatomiſt, *Monſ. du Verney*, traced the eighth and ninth pairs, the medulla ſpinalis, and the intercoſtals. The child was well proportioned; the cranium, brain, and cerebellum, were wanting; in lieu thereof, remained only a ſubſtance, like congealed blood, covered with a membrane.

3. In a caſe related, and largely commented upon, by the celebrated *Wepfer*,* which differs in many reſpects from other children ſaid to be without brains, the child was well proportioned, its head of the uſual ſize, but its brain had degenerated into veſicles, or hydatides, each of which had its blood veſſel, (might one from thence infer, the natural ſtate of the cortical ſubſtance of the brain to be cellular?) and the optic and auditory nerves took their riſe from three portions of medullary ſubſtance, lying upon the ſphænoid bone near the ſella equina.

4. Theſe ſingular exiſtences afford uſeful inferences, and ſhew, that the irritability of the heart is capable of being ſuſtained, by very low degrees of the nervous power, while that irritability is kept up by the foſtering heat of the mother. This feeble life is ſoon extinguiſhed, when the influences of the mother's warmth and circulation ceaſe. (No. 1.) Such infants die as ſoon as born, or ſoon after.

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* Manget Biblioth. Anat. Vol. ii. p. 339.

5. Such examples, more conſequentially than experiments, demonſtrate that the ſpinal marrow is the principal origin of the intercoſtal nerves; (No. 2.) and, better than ligatures, illuſtrate their vaſt importance.—For,

6. From the plump ſtate of the body, and vigorous appearance of the heart, it is evident the circulation, and the developement of the ſeveral organs, had been carried on properly in the fœtus; and that the irritability of the heart, derived a ſufficiency of nervous influence from the intercoſtal nerves, and its ganglions, and, theſe again from the ſpinal marrow, for growth, and that ſtate of exiſtence.

VI.

Of the appearances of URINE, *in diſeaſes attended with a ſtate of blood tending to putreſcence. By* James Johnſtone, M. D. *of Kidderminſter.*— *Firſt publiſhed in the Medical Muſeum.—Vol.* ii. *p.* 511.—1763.

IN the malignant feveriſh diſorders which have often fallen under my care in this neighbourhood, from the years 1752 to 1757, I have almoſt conſtantly obſerved that the Urine was turbid, or dropped a copious ſediment very early in the diſeaſe, without the leaſt amendment in conſequence thereof; and that afterwards, when the diſeaſe was abating, and in its decline, the Urine then became clear, without being followed by any relapſe.

Finding it difficult to reconcile theſe phænomena with the obſervations of the ancients, as they are uſually interpreted in the ſchools, I then began to be perſuaded, that this turbid appearance in the Urine, might indicate a diſſolved and putreſcent ſtate of the fluids, both in acute and chronic diſeaſes. I reaſoned thus:

" In continual fevers of the inflammatory claſs, a criſis is moſt probably brought about by a reſolution of the too denſe particles of our fluids, analogous to that, which, carried to exceſs, cauſes often malignant, putrid, petechial fevers: of this ſalutary reſolution of the morbid matter, in inflammatory diſeaſes, (or ſuch as are attended with a denſe ſtate of the fluids,) a ſediment in the Urine is an effect and ſign.

In putrid fevers, the blood is ſtill more melted down; and the putrid matter, being more copiouſly mixed in the Urine, gives it that turbid appearance, ſometimes with, and ſometimes without, a ſediment; which appears generally in the very beginning of ſuch fevers, giving a very dubious omen of their event: but a turbid Urine, ſhews a greater degree of diſſolution in the humours, than a mere ſediment, which muſt be denſer than thoſe particles which remain mixed in the Urine. A clear yellow Urine, at or after the height of theſe fevers, is rather a ſalutary and promiſing appearance in them, ſhewing the contexture of the blood is as much inſpiſſated, as the health of the individual requires, and that the diſſolved and corrupted parts of the fluids, or the morbific matter of theſe fevers, in other words, is thrown off or altered.*

The obſervations which I have made ſince, in all the different ſpecies of putrid diſeaſes, perfectly confirming and agreeing with the above, have made me no longer doubt, but that a turbid, thick, or ſettling Urine, is as much a characteriſtic of a putrid tendency and diſpoſition in the fluids, is as invariably connected with ſuch a condition of the blood, as a limpid Urine is with ſpaſms; and that without a fever, ſuch a foul, turbid Urine is, as very celebrated writers have affirmed, a diagnoſtic ſign of the ſcurvy; and that with a fever, eſpecially in its increment, or without remiſſion, it ſhews the fever to belong to the putrid claſs, in which the texture of the blood is running into putreſcence and diſſolution, from ſome general apt cauſe, or topical fomes.

Generally ſpeaking then, whatever the diſeaſe be which is attended with a very foul, turbid Urine, the diſeaſe ſtill ſubſiſting in its vigour, it may be preſumed to ariſe from a diſſolved, putrid

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* See an Hiſtorical Diſſertation concerning the malignant Fever of 1756, &c. at Kidderminſter.

craſis of the blood, and we may conclude it to be one proper ſign of putrid and malignant fevers.

In this claſs of fevers, ſuch an index of the blood's ſtate is more particularly uſeful and deſerving of attention, as venæ-ſection is, for the moſt part, in ſuch circumſtances, a dangerous practice.

If the relation of a thick Urine to a corrupted blood, needed any other proof than faithful obſervations made in diſeaſes, this might be drawn almoſt to demonſtration, from eaſy experiments upon the Urine itſelf; for the clear Urine of the moſt healthful perſon, ſtanding in a room moderately warm, about the fifth day, ſmells highly putrid, and at the ſame time is become turbid, with a ſcum on the ſurface, and a ſediment at the bottom of the glaſs: it reſembles the Urine of perſons labouring under putrid fevers, and a ſcorbutic habit; and this imitation may be rendered more exact, by mixing at firſt a little pus with the recent Urine.

The ſame truth might be ſupported by facts, related in the works of Dr. *Huxham*, as well as in thoſe of more ancient obſervators, of the beſt credit; but I ſhall, inſtead of a great variety much to our purpoſe, now only quote a paragraph in the ſeventh part of the Ratio Medendi of the juſtly celebrated *De Haen*; a more extraordinary caſe is hardly to be met with.

" A young man, twenty-four years old, on the 12th of December, 1761, had the trunk of the femoral artery intercepted by ligature, for an aneuriſm; with much care, he recovered the warmth and perfect uſe of the limb: the patient was for three or four months threatened with frequent returns of gangrene, for which the bark was liberally uſed, both internally and externally; it was uſed internally till the month of Auguſt following." *De Haen* took notes of the various appearances of the Urine, in the whole courſe of his attendance upon this patient, and that more than once, every day. " The day before the operation was performed, the Urine was thick, and continued in that condition for ten days after: from the time he uſed the bark, the Urine was leſs turbid, and ſooner ſettled, but was unuſually high coloured.

" January 2d and 3d, things going on well, the Urine had a natural appearance; but on the four ſubſequent days, degenerated into the former ſtate. From January 8th, the Urine was redder, with a thick whitiſh ſediment, which ſoon ſubſided, with a furfuraceous appearance near the ſurface,

face, and this was covered with a pinguious pellicle, which in different lights appeared yellow, reddiſh, purple, and green: while the Urine was in this ſtate, the quantity of pus was great for the compaſs of the wound; and that which came from its more ſinous receſſes, was fetid.

"January 14th and 15th, the pus voided was little in quantity, and hardly fetid; the urine alſo had ſcarce any ſediment, ſcarce any pellicle, ſcarce any colour, but what is natural; when the gangrene afterwards appeared with feveriſh ſhiverings, the Urine again was thick, turbid, and covered with a ſcum as before; and after it had ſtood longer, dropped a thick ſediment: when the gangrene was ſtopped, the Urine was turbid indeed, but preſently ſettled, with very little ſcum, and at length almoſt became natural.

February 28th, a feveriſh horror uſhered in a great gangrene, the Urine became again thick, turbid, furfuraceous, and covered with a ſcum as before: while we were long ineffectually ſtruggling with this gangrene, by increaſing greatly the doſes of the cortex, we were ſurprized to find the Urine appear natural for three weeks together, excepting only twice. Natural, I call the Urine, becauſe it only differed from the natural, by the addition of a thickiſh ſuſpenſion, or nebula, with a little farina in it.

" The cauſe of this digreſſion is, if poſſible, to illuſtrate the intricate doctrine of Urines: but how obſcure, how abſtruſe, how inexplicable is it! The Urines obſerved ſome kind of explicable order to the end of the laſt gangrene, none after; by the help of the cortex in the early gangrenes, they changed for the better; after the laſt gangrene, though the bark was ſtill continued in the ſame doſe, the Urine was ſurpriſingly various. But whence were the Urines ſo often turbid and jumentoſe? In fevers, ſuch appearances denote obſtinate crudity, with a beginning, but vain effort to produce coction; but here they denote a gangrene and ſphacelus: ſuch a pellicle as here appeared, is ſaid to preſage ſcurvy and calculus, but in this caſe, it always attended mortification."

If it ſhould appear that theſe phenomena in the Urine, which ſo much perplexed this learned, this ingenious author, ariſe from ſome degree of putrefaction in the blood, and are ſigns of it, and that this putreſcence is, in a certain meaſure, the common cauſe of ſcurvies and putrid fevers of various kinds, and, in a higher degree, of gangrenes, we apprehend the principal difficulties attending the explanation of Urines, in ſuch caſes, will vaniſh, as well as many others, attending the doctrine of crudity and coction in general.

Kidderminſter, Oct. 16, 1763.

VII.

CASE

OF

GEORGE

LORD LYTTELTON.

CASE

OF

GEORGE LORD LYTTELTON.

LORD LYTTELTON, whoſe caſe, and the laſt illneſs which terminated his valuable life, (I am about to deſcribe, from notes ſet down at the time,) was born at the end of the ſeventh month of pregnancy: and the delicate frame of body which he brought into the world, in a great meaſure, accompanied him through life.

His make was tall and ſlender, very remote from being robuſt. He had been often incommoded with attacks of encreaſed ſecretion of bile; yet by temperance, and proper management, he arrived at the ſixty-fourth year of his age, not only with a tolerable ſhare of health, but with a conſiderable degree of enjoyment; notwithſtanding various occaſions of uneaſineſs, and domeſtic diſappointment, which had occurred to him.

His mind, magnanimous, and firmly religious, was beſides ſupported, by his mental and literary amuſements, his ſocial enjoyments, his public duties, and his learned labours. The ſolace of the *Cicero*'s, the *Raleigh*'s, and *Clarendon*'s, under the preſſure of misfortune, was alſo that of this great and good man.

When he came to his country ſeat, in July, 1773, he complained, that for ſix weeks before he had generally paſſed his nights in a ſleepleſs ſtate; that he felt a debility and languor gradually encreaſing, with want of appetite, yellow icteritious urine, a white tongue, a weak pulſe, but ſcarcely quick, or feveriſh. He complained alſo of a flatulent and tenſe abdomen, and withal of dyſpnea.

To remove theſe ſymptoms, I ordered fifteen grains of powder of rhubarb, at bed-time, in a ſaline draught; and a ſtomachic mixture at noon.

July 27. Finding ſome increaſe of bilioſe and feveriſh ſymptoms, I ordered the following, two ſucceſſive mornings.

R. Infus. ſennæ commun. unc. ii.
Aquæ menthæ pip. ſimplicis. unc. i.
Pulveris rhei, tartari vitriol. aa. ſcrup. ii.
Sacch. alb. cortici limonum attrit. drach. ii.
M. f. hauſt. No. ii.

He had beſides, twice in the day, a ſaline draught of ſuccus limonum, with ſal. abſinthii in a ſtate of effervefcence. He took four of theſe.

Auguſt 1. His urine was now of a natural colour, and his belly leſs tenſe; I ordered twenty drops of acid elixir of vitriol, to be taken twice daily, in a glaſs of water; and three of the following pills at bed-time.

R. Gumm. ammon. drach. i.
Pil. Rufi, ſemi drachmam, f. pil. xviii.

Auguſt 9. His Lordſhip returned from a viſit to Sir *Edward Lyttelton*; and had taken his laſt ordered medicines.—He had been better, but his ſleepleſs nights had not left him.—In all this time he had only one good night: in every other night, he was conſtantly diſturbed when going to ſleep, by palpitations, and ſhort breathing.—His pulſe, in all this illneſs, irregular.—His urine bilious and high coloured: his tongue white, his eyes and ſkin brown: his ſtools always of a chocolate brown colour, never inclined to white. — Beginning to diſlike his opening draughts, he took inſtead, a quarter of an ounce of cream of tartar, in barley water, in the morning; and twenty drops of acid elix. vitrioli, in Pyrmont water, twice in the day. —At night, ten grains of rhubarb: by this courſe, he was kept open the whole of this week.—His urine and ſkin acquired, at times, their natural colour. But his ſleep was every night interrupted by palpitations, and ſhortneſs in breathing, though, in the day, free from theſe ſymptoms.

I dined with him the 14th of Auguſt, the laſt time he ſaw company: he had been very languid in the morning; after dinner, and a few glaſſes of wine, he grew cheerful: I urged his taking a little fruit, and a glaſs or two of wine at ſupper; to try if a fuller diet could diſpoſe him to ſleep; but this had no better effects, than his ſpoon meats, and ſtricter diet, which he had obſerved for ſome time, while he was taking his opening draughts: his ſleep continued to be interrupted: and though the bilioſe ſymptoms ſeemed ſubdued for a time by his medicines, yet they ſtill returned, and inſtead of regaining ſtrength, it continued to ſink.

Auguſt 16, I found the ſupper and wine allowed, had in no degree contributed to remove his Lordſhip's reſtleſſneſs, — He never ſlept at night, without the ominous interruption, by palpitations and ſhort breathing, already mentioned.—The biliofe appearances in his urine returned, his tongue was white, his eyes were yellow; his pulſe low, irregular, and rather too quick: the liver felt a little hard, and the hypochondrium tenſe.

Hitherto opiates had been avoided, as it was apprehended, they might interrupt the efficacy of the means, by which the biliary ducts were to be opened, and the ſuperfluous gall carried off.—But as the uſe of gum ammoniac and camphor, in pills, had failed to produce reſt, and as increaſing debility, and univerſal hurry of nerves, were the conſequences of the want of ſleep: 'twas now thought proper to give an opiate at night, and to perſiſt in the uſe of the aperient, and deobſtruent medicines in the day, to ſuch a degree, and in ſuch doſes, as ſhould keep the body open; this evening he had a draught, with twenty drops of laudanum in tinct. ſacra.—He reſted well, and was much refreſhed in the morning. But the ſame draught had no ſuch effect the night of the 17th,—he had then no reſt, his breathing was ſhort, and palpitations as great as they had ever been.

Stools were procured by the means already ordered, and by chamomile glyſters, thrown up two or three times a day.

18th. I preſcribed pills with camphor, rhubarb, and aſſafœtida: he took them, though with much reluctance and diſguſt, as the ſmell of aſſafœtida was particularly diſagreeable to him: — He had purging ſtools, but began to be fainty, and his pulſe very low, as well as irregular, with cold clammy ſweats over his body. — This evening, he had two or three doſes of tinct. thebaica, of twenty drops each doſe, and had ſome refreſhing ſleep: his pulſe was found regular, while the effect of the opiate laſted.

19th. When he got up, he was depreſſed, faint, and ſick, and had a coldneſs all over him: this was ſuppoſed to be an effect of the opium. —I encouraged him to vomit, with chamomile tea; he threw up ſome yellow bile, and his ſickneſs ſeemed removed by it.

20th. He took, in diſtinct doſes, near 120 drops of tinctura thebaica this night, but without procuring reſt: — the lowneſs of his pulſe, depreſſion, palpitations, and proſtration of ſtrength, very great. A vomit of ipecac. wine, and antimonial wine, was taken, but very little bile was brought up by it.

He had taken the tinctura ſacra, to day, without procuring ſtools: this evening, he took twenty grains of pil. Rufi. and twenty-four drops of tinct. thebaica, with ten drops of ſpir. vol. aromat.—this laſt doſe was repeated four times this night ineffectually: the pil. Rufi. was repeated in the morning.

21ſt. At my deſire, Dr. *Aſh* was called in to my aſſiſtance. His Lordſhip had ſlept from five to eight o'clock in the morning: he was then warm, his pulſe ſtronger, though irregular, and he was now free from ſhortneſs in breathing and palpitation. The Doctor and I agreed in the indications, to clear the biliary ducts, and carry off bile; and the following draughts were preſcribed by us.

R. Tinct. ſacra ſpir. unc. ſs.
Aq. menth. pip. ſimpl. unc. i.
Tart. vitriolat. ſcrup. i. Sal. abſinth. gr. iv.
f. hauſtus—to be repeated once in four hours: and extract thebaicum, was ordered to be taken at night, and chamomile glyſters to be occaſionally injected.

The remiſſion of ſymptoms, during which theſe meaſures were directed, ſoon ceaſed; and by the encouragement of my aſſiſtant, his Lordſhip took cordials, brandy and water, and citron water, in conſiderable quantities, but was very little relieved by them. The extractum thebaicum procured no reſt this night; and he had the additional ſymptom of much thirſt.

22d. About noon, his Lordſhip found his dyſpnea, and hurry return: about ſix o'clock in the evening, he was ſeized with the rattle in his throat, and with an univerſal coldneſs. He found himſelf a dying man, and expreſſed his belief, of that being his ſituation, with great reſignation, and inſtruction to all around him! He continued to drink citron water, and brandy mixed with water, with drops of ſpir. volat. aromaticus. Bliſters were applied, one to his ſtomach, and another to his arm, near the axilla. But the alarming ſymptoms continuing, three whole papers of *James*'s powder were adminiſtered in the night; and a very free evacuation by ſtool followed in the morning: but the ſweats continued cold. In the forenoon of the 23d, he recovered his heat, and he breathed with leſs difficulty; and he now ſwallowed old hock, and other drinks. He was better, but to no ſuch degree as encouraged *me* to expect amendment, much leſs recovery.

This evening the bad ſymptoms returned: he again repeated two or three whole papers of *James*'s powder, but no evacuation followed; and his abdomen, notwithſtanding former evacuation, became more tenſe,[c] and tympanitic. His cold ſweats returned, and he died about ſeven o'clock in the morning of the 24th of Auguſt, 1773.

He was opened by Mr. *Cauſer*, ſurgeon to the family. — The brain was not examined: the liver was found hard and enlarged, but no pus was obſerved in it. The gall-bladder was diſtended, and full of black bile: bile abounded in the duodenum, and the adjacent parts were very much tinged with it: — the gall ducts were found free from obſtruction. In the thorax, the left lobe of the lungs adhered to the pleura almoſt in every part: the lungs of the right ſide were free from adheſion: — no polypus was found in the heart, or great veſſels: no water in the pericardium or thorax—no adheſion of the pericardium to the heart; no oſſification in the heart.—In the abdomen, ſome adheſions of the inteſtines to the pericardium were obſerved in the left ſide of the body.

His Lordſhip's bilioſe and hepatic complaints, ſeemed to me inadequate, ſingly, to the production of this fatal event.

In diſſection, no ſufficient cauſe, no morbid ſtate, appeared in the thorax, which might have cauſed the palpitations, dyſpnea, and fatal interruption of ſleep.

Theſe ſymptoms, aroſe moſt probably from an exhauſted ſtate, and defect of nervous power, which can never be viſible in diſſection.

Irritations, attending a debilitated ſtate of nerves, are often the cauſe of bilious ſymptoms.

The want of ſleep, for ſo long a time, whatever might have been the occaſion of that, ſufficiently accounts for his Lordſhip's gradual, and even rapid, loſs of ſtrength, and for the fatal conſequence.

The reſtoration of animal power and ſtrength, by ſleep, in our ſyſtem, is indeed of ſuch abſolute indiſpenſable neceſſity, that a long want of it, muſt terminate in madneſs or death.

That it did not terminate in the former calamity, muſt be matter of joy to all, who knew the virtues of this excellent man, as much as they muſt ever lament their loſs and misfortune, by the latter event.

This ſad caſe affords inſtruction and warning to the ſtudious, the delicate, and the anxious breaſt.

Sleep, tired nature's ſweet reſtorer, cannot be ſafely diſpenſed with. But the proper times and neceſſary duration of it, to each individual, depends much upon cuſtom. Study, protracted far into the hours of night, cares harboured, and, even very late hours in company, by encroaching on the hours of ſleep, are ſure to bring on debility, with all its extenſive conſequences; and nervous irritability, with the innumerable dire diſeaſes in its train.

They put the brain more or leſs in a ſtate unapt for reſt, in a ſtate of uneaſy vigilance: and a multitude of facts, in the ingenious tract of *Tiſſot* on the diſeaſes of literary and ſedentary perſons, ſhew, that the aptitude of the brain, to reſtore by ſleep, the impaired energies of the animal frame, may be loſt altogether, and, fatal conſequences, ſimilar to what I have exemplified, and others equally melancholy, enſue.

Much it imports, therefore, the ſtudious, to limit their learned labours to proper hours, to ſupport ſtrength by intervals of exerciſe in the open air, and, to all others to ſolicit ſleep, by a ſeaſonable and early diſmiſſion of buſineſs and of care; and to compleat the inſtructions to be derived from this great example, to live virtuouſly, and to die with reſignation.

The publication of this caſe ſeems to me proper, as I have had the honour to be referred to by an eminent writer, for an account of the laſt moments of Lord *Lyttelton*; and an extract from a letter, I wrote by his dying command, to an excellent lady, a luminary ſtill brightning our horizon, was, by accident, publiſhed in the very prejudiced account that author has given of his Lordſhip. (See *Johnſon*'s Lives of the Poets.)

The following character, drawn for another nobleman, by the pen of *Eraſmus*, is ſo perfectly applicable to that of Lord *Lyttelton*, that I yield to the impulſe, I feel, to inſcribe it, as a tribute of veneration to his memory. He was indeed, "Inter doctos nobiliſſimus: inter nobiles doctiſſimus, inter utroſque optimus: ut enim antiquam generis claritatem eruditione.—Eruditionem, miro vitæ candore decoravit; ſic his omnibus, omnium pulcherrimam apicem, et colophonem addidit, admirabilem animi modeſtiam!

VIII.

Some Account of HEPATITIS SUPPURANS.

IT is certain, from obſervations of gentlemen who have publiſhed deſcriptions of the diſeaſes of warm climates, that diſeaſes of the liver are there very prevalent.

They are alſo often met with in this country, eſpecially during hot ſeaſons: this fact, which is, perhaps, not ſufficiently impreſſed on the mind of every practitioner, will apologize for the following ſhort account of a few remarkable caſes of the Hepatic kind, which have lately come to my knowledge. [1789.]

The Hepatitis has been ſo well deſcribed by *Boerhaave*, and his excellent commentator, and others, that it is not my deſign to attempt a general deſcription of the cauſes, ſymptoms, and treatment of this malady.

A very free uſe of mercurial unction, has been much inſiſted upon, as a ſalutary practice in this diſeaſe, as it has occurred in the Eaſt Indies: and calomel, repeated in proper doſes, has been found greatly to aſſiſt the efficacy of other deobſtruent and antiphlogiſtic remedies proper in this diſeaſe, as it has occurred at home.

In the ſummer of 1787, four perſons were, nearly at the ſame time, ſeized with an illneſs, which was fatal to three of them, and for ſome time created a ſuſpicion of poiſon.

They had been all employed in cutting down timber, in a wood ſituated in a deep gully, near Shakenhurſt, in the month of June, the weather being wet, and at the ſame time uncommonly hot.—They were all ſeized with a profuſe evacuation of green bilioſe ſtools, except one.

They complained but little of pain in the right hypochondrium, had no icteric yellowneſs, and but little fever, till the near approach of death.

Three of theſe perſons were committed to the care of Mr. *Gomery*, a diligent ſurgeon in Bewdley,

ley, in conſiderable practice, of whom one recovered: mercurial ointment was rubbed upon the abdomen of this perſon; and he took beſides, decoction of bark and tartar. vitriol. this method, in itſelf highly proper, ſucceeded in this patient, whoſe attack was much milder, than that of his companions, becauſe ſuppuration had not taken place.

On opening the bodies of the three who died, (as will appear from the narrative of the caſes and diſſections here added, with which I have been favoured by the gentlemen who attended,) the liver was found ſuppurated to a prodigious degree. In more than one, the matter had eroded the diaphragm, and made its way into the right ſide of the thorax.

This was remarkably the ſtate of one of the bodies I inſpected with Mr. *Gomery*; (ſee Caſe ſecond;) in which the right lobe of the lungs, as well as the liver, was much eroded and conſumed: and the quantity of purulent matter, collected from the liver and cavity of the thorax, ſeemed to me near half a gallon. The ſkin of this perſon had no appearance of jaundice, and his ſymptoms in the courſe of his illneſs, did not differ from thoſe of the reſt.

Mr. *Seager*, an experienced ſurgeon of Bewdley, and coroner for the county of Salop, favoured me with the hiſtory of one of theſe unfortunate men committed to his care.

W. Stokes, aged forty, wood-cutter, July 7, 1787, applied to me: he complained of pain in his ſtomach and bowels, attended with diarrhœa.

Theſe ſymptoms ceaſed, and I ſaw him again July 19; he then complained of pain in the right ſide, with ſlight fever, and a ſlow pulſe: a bliſter applied to the ſide, removed the pain; but the fever remained.

July 23, he was ſeized with cough and ſickneſs: this laſt was relieved by an emetic; but the cough continued till the 10th of Auguſt, when he expired.

He had no icteric ſymptom in the whole courſe of this illneſs.

On opening the body: — in dividing the cartiledges from the ribs, to raiſe the ſternum, two quarts of matter iſſued out from the liver, and as much more was found in the right ſide of the thorax: Mr. *Seager* did not recollect any appearance of eroſion in the diaphragm, which, nevertheleſs, had moſt probably taken place. The pericardium contained a conſiderable quantity of lymph; the inteſtines looked as if they had been well injected, and were greatly inflated with wind.

Notwithſtanding the alarm of poiſon, no evidence notified the ſuſpicion: and it is ſufficiently clear, the malady aroſe from their buſineſs and ſituation, expoſed to a hot ſun, and lying in wet cloaths; the ground covered with rotted leaves; and the taking in greedy draughts of water, and other cold liquors, in their heated ſtate: the application for medical aſſiſtance was late, and probably not till after the ſtate of ſuppuration had taken place in three of them: and 'twas diſſection which diſcovered that, before unſuſpected, ſtate.

Bontius, in his account of the Hepatitis of the Indies, recommends an external opening by cauſtic, as the only remedy for the apoſtem, which follows inflammation of the liver; and it has often ſucceeded ſince his time.

Dr. *Fordyce*, (Fragmenta Chirurg.) was ſucceſsful in curing an abſceſs of the liver, by an external opening: another caſe of that nature was treated in the ſame manner, but without ſucceſs, and the patient died hectic. The abſceſs, originally in the liver, had eroded a paſſage into the thorax, as in the caſes here related.

Theſe abſceſſes form adheſions to the peritoneum, and ſometimes make their way through the muſcles of the abdomen; and are often cured by an external aperture, of which an inſtance occurred in our hoſpital, in the caſe of one *Macmaſter*, in 1789, under my care.*

Bontius, in deſcribing the cauſes of the obſtruction and inflammation of the liver, occurring frequently in the Indies, aſcribes them much to the abuſe of arrack: "Dum enim ejus hauſtu, ebrioſi *iſti calefacti*, ingentem aquæ copiam in ventriculum ingerunt, dein humi tanquam pecudes procumbunt, & in navibus ſe rori, qui poſt ſecundam aut tertiam noctis horam, copioſe cadit, exponunt; inde Venenatos Vapores 'e terra erumpentes, intra corpus recipiunt, & ſic obſtructionem hepatis facillime incurrunt, cui adeſt tenſiva, in hypochondrio dextro, gravitas, *dolorque obtuſus*, & quaſi pondere premens." &c.

The deſcription of *Bontius* exactly agrees with what happened to the wood-cutters, and, in the following remarkable caſe.

I was called Auguſt 21, 1789, to a farmer near

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* See three caſes of abſceſs of the liver terminating in empyema, p. 137 and 573 of third vol. of Med. Memoirs, London. And an account of Hepatitis in Dr. *Saunders's* learned treatiſe on the ſtructure and diſeaſes of the liver.

Leominſter, of the age of forty years, and of a robuſt make. Three weeks before, he had been exceſſively fatigued in pitching up hay upon a rick. He was ſeized with pain in the bowels and ſtomach; after which a tumour gradually roſe to a conſiderable ſize, in the region of the liver, ſtretching over and acroſs the ſtomach, with great tenſion and ſenſe of weight: a quick regular pulſe, with much heat and thirſt, but no yellowneſs of the ſkin, or bilious appearance in the urine: the uneaſy weight of the tumour, though the pain, properly ſo called, was dull and inconſiderable, made him ſtoop forwards, and ſupport his body on a table. The bulk was ſo large, as to force the diaphragm and heart very high up the thorax; for I felt the throbbings of the heart, near the ſternum, betwixt the fourth and fifth ribs. He had four or five ſtools daily, which fermented like yeaſt.

Believing the diſeaſe to be a Hepatitis, verging to ſuppuration, and with little expectation of effecting a cure, I deſired Mr. *Geary*, the able ſurgeon who attended him, to repeat venæ-ſection: and to rub, every other day, half a drachm of ung. merc. into the hypochondria, and to take the following medicines.

R. Tinct. theb. gutt. xv.
Oxymell. ſcillit. ſemi drachmam.
Vin. antimon. gutt. xx.
Julep. camphorat. unc. i. f. hauſtus ſumendus hora ſomni, alternis noctibus.

R. Camphoræ pulv. Jacob. aa. ſcrup. ſs.
Pil. ſcillit. drach. i. f. pil. xviii. cap. pil. iii. bis vel ter die.

R. Decoct. pectoral. libr. ſs.
Tartar. vitriolat. drach. ii. ſacch. alb. ſemunciam m. cap. coch. ii.—tertiis horis.

I enjoined the liberal uſe of cheeſe whey, as his principal, or only drink, to which his great thirſt diſpoſed him to a ready obedience.

In a few days he had an immenſe diſcharge of a dark coloured, purulent matter, by ſtool, and the ſwelling gradually ſubſided.

Though the relief he had from this effort of nature, gave ſome hope, it was ſtill apprehended, the ſuppuration which had taken place, would gradually conſume him:—and I ordered the following medicines, with a fearful expectation of the event. A ſmall doſe of pulv. Doveri. at bed-time, and decoct. cort. Peruv. with tartar. vitriol. and myrrh, three or four doſes daily.—I heard of his recovery, but did not give entire credit to the information, till I ſaw him a year after, in perfect health: in which ſtate he has continued, as I am informed, to this time.

He has no fulneſs in the region of the liver, or any other remains of it, to be perceived, except ſome degree of hardneſs, which I thought I felt in that part.

This is one of thoſe caſes, in which the event was favourable beyond expectation. *Boerhaave* has an excellent and comprehenſive ſection on the Hepatitis multiplex, in the Aphoriſms; one of thoſe productions which ought to be eternal, and which ſhould be daily in the hands of phyſicians. Here, that great man points out the various channels, by which the purulent matter, formed in the Hepatitis, may be diſcharged. As the diſeaſe, in a ſlight degree, is, I believe, not uncommon, and yet is ſeldom ſuſpected, from the ſlight dull pain, or total want of it, and the abſence of jaundice, I hope theſe obſervations will have their uſe, in exciting the circumſpective attention of practitioners in all caſes, and in ſupporting their diligence and hope, in the worſt caſes.

When a diſeaſe, with ſome fever, is attended with a bilious colour in the urine and ſkin, and a fulneſs, with heavy pain, and uneaſy ſenſation in the right hypochondrium, a diſeaſe in the liver will naturally be ſuſpected: but ſuch a diſeaſe often occurs without any ſuch ſymptom, and then is only to be diſcovered by a nicer attention to a chain of circumſtances, which lead to the diſcovery of the part affected: ſuch particularly are, a certain degree of hardneſs and fulneſs felt in the liver, accompanied with thirſt, heat, anxiety and uneaſineſs about the ſtomach, with want of appetite, low fever, and ſuch antecedent cauſes, as are known to occaſion inflammatory diſeaſes: beſides, the experience and ſagacity of a phyſician will, for the moſt part, direct him to a right judgment of the diſeaſe, and method of cure.

The memoires of *M. Petit* the younger, and of *M. Morand*, in the Memoires de l'Acad. de Chirurgic. 2 tom. contain obſervations on the chirurgical management of abſceſſes of the liver, which deſerve to be conſulted.

The formation of pus in the liver, is ſometimes very ſudden, as in three of the wood-cutters, and in *Maſon*, eſpecially if the inflammation be acute, and the fever, its principal ſymptom, be conſiderable: nevertheleſs, it is formed often when the fever was not very conſiderable in the beginning: and ſometimes, the formation and congeſtion of matter, is very ſlow.

The pains complained of in this diſeaſe, are ſeldom acute, unleſs the inflammation attacks the ſurface of the liver, the ſuſpenſary ligament, the peritoneum, and the diaphragm.

When the concave ſurface of the liver is concerned, the pains ariſe from the inflammation affecting the contiguous membranes, and nerves of the gall-bladder, the ſtomach, the duodenum, and the colon, which is often eroded by the pus, and by that way it makes its exit from the liver, and is diſcharged by ſtool.

The dull ſenſation of the liver in an inflammatory ſtate, was obſerved by *Galen*, and the ancients; the obſervation has received repeated confirmation from the beſt authorities.—*M. Petit*, *M. Morand*, and Dr. *Heberden*, take notice of it.—*M. Morand*, aſcribes the inſenſibility of the liver, in a morbid ſtate, to its having but few nerves. The fact, however, is, that the liver has a conſiderable ſupply of nerves; and the inſenſibility obſerved in it, in common with the pancreas, ſpleen, and other parts ſupplied with nerves, from the great ſympathetic nerves, ariſes from the ganglions, whence reſults the obſcure and indeterminate ſenſation of all the viſcera in the abdomen.

Abſceſſes in the upper and convex ſurface of the liver, which are probably the moſt frequent, erode often paſſages through the diaphragm into the thorax.

M. Petit, records the caſe of a patient ſo affected,

by

by *M. Taillard*, in which the matter pointed outwardly, and a fluctuation directed to the performance of the operation for the empyema, by which a very great quantity of matter was voided; and in paſſing the finger into the breaſt, he felt the hole in the diaphragm, which went into the convexity of the liver, the original ſeat of the abſceſs. The patient was cured, and the wound healed in ſix weeks.

Another encouraging circumſtance worthy to be noted, is, that though the waſte of the ſubſtance of the liver, by the formation of ſuch prodigiouſly large collections of matter, be great, yet when the matter is evacuated, the healing and regeneration of the conſumed ſubſtance, is very ſpeedy.

In a patient labouring under an abſceſs of the liver, who died, *M. Pibrac* found the abſceſs contiguous to the colon, which was eroded by the matter; and it appeared in the ſtools of the patient ſome time before death. This patient had not ſtrength to ſupport her under the diſcharge, and, to enable her to receive the advantage, of this effort of nature, which ſeems the only reſource in abſceſſes thus ſituated.

In the valuable collection of obſervations, of the late Dr. *Stork*, the following is recorded, p. 8.— A man, A man, aged thirty-four years, during a bloody flux, had alſo a tumour in the right hypochondrium.—The bloody flux ſtopped in three months, and in two more, the tumour broke outwardly, and diſcharged a pint of thick reddiſh matter.—After this, the purging returned, and he died in ſeven months from the firſt attack.

The edge of the right lobe of the liver, and the neighbouring part of the tranſverſe arch of the colon, were found adhering to one another, and all of them ulcerated. The colon was at that part perforated by ſmall apertures, and its internal coat near the apertures, irregularly eroded. *Stork*'s works, 4to. p. 8.

An adheſion is ever eſſential to the happy and fortuitous efforts of nature.—Meſſrs. *Morand*, *Petit*, and others, compare the appearance of the matter, to that of the lees of claret. *Maſon*'s was of this colour. He was relieved, probably, by an eroſion of the colon, ſimilar to Obſ. iv. in the Memoire of *M. Petit*.

Abſceſſes, moſt likely to be relieved by operation, are ſuch as point outwardly, and in which a fluctuation is felt in the epigaſtrium, beyond the margins of the cartiledges of the ribs. That was the ſituation of the abſceſs, in the four patients cured by *M. Morand*, whoſe method of operation and dreſſing, in ſuch caſes, deſerves the attention of ſurgeons and phyſicians.

I now cloſe theſe obſervations, by adding Mr. *Gomery*'s account of two caſes of the unfortunate wood-cutters, one of them not before deſcribed; and I have only to remark, that the adheſion of the inflamed part, and of the abſceſs which follows, is always neceſſary to prevent the effuſion of matter into the cavity of the abdomen, and is the only natural circumſtance, by which art or nature can effect a happy termination of the diſeaſe.

IX.

Two Caſes of SUPPURATED LIVER, *communicated by Mr.* Robert Gomery, *ſurgeon, in Bewdley.*

1. BENJAMIN DALLER, ætat. forty, of a ſpare, thin habit, was attacked on Monday, the 25th of June, 1787, with a diarrhœa, and griping pain in his bowels, which continued, without any other complaint, except ſome loſs of appetite, and debility, about a week; — his ſtools were dark coloured, and ſometimes ſtreaked with blood: — he then complained of pain in the right hypochondrium, which was acute upon deep inſpiration, or motion, and attended with ſome difficulty of breathing: the diarrhœa ſtill continued. On the 12th of July, the pain and dyſpnea were very conſiderable; his pulſe rather quick, and very ſmall: he had ſome thirſt, though his tongue was clear and moiſt, and his ſkin not particularly hot;

the purging ſtill troubleſome, his ſtools ſlimy, but not dark coloured. A ſhort dry cough came on ſome days after, with increaſe of pain, and difficulty of breathing, particularly upon lying down; and a ſenſe of fulneſs, and ſoreneſs, in the region of the liver: his pulſe became rather quicker, but was ſtill very ſmall, and his ſkin not hot: — he complained of head-ache, and his ſleep was much diſturbed; — his urine rather high coloured, made in ſmall quantities, and with pain; appetite very indifferent. He was now much emaciated and weakened — the diarrhœa ſomewhat abated. —— On the 17th, the pain and ſoreneſs were very great, with conſiderable fulneſs in the region of the liver; the cough and dyſpnea ſo much encreaſed, as to render his lying down almoſt impracticable. — He now complained of a pain in his right ſhoulder, and his legs were much ſwelled: the ſecretion of urine ſmall, voided with pain, and high coloured. His eyes and countenance had a yellowiſh caſt: — his pulſe very ſmall and weak, rather quick; but his ſkin little hotter than natural: ſcarce any thirſt, but total loſs of appetite.—His cough was attended with very little expectoration. In a ſhort time he was unable to lie down, but obliged to reſt with his head inclined forward upon a pillow: his ſtools, which were now leſs frequent, became pale coloured; pulſe extremely weak; his legs cold, and very much ſwelled. In this ſtate he languiſhed till the 24th, when he died ſuddenly, without a groan.

Appearances on Diſſection.

The liver appeared much enlarged, and very dark coloured on the lower part; the gall-bladder much diſtended with bile. A quantity of coagulable lymph lay upon the lower part of the convex ſurface of the right lobe, by which it ſlightly adhered to the peritoneum; higher up, under the diaphragm, it adhered very much, and upon being ſeparated, a large quantity of thin curdly matter, of a browniſh colour, guſhed out: upon further examination, ſeveral large abſceſſes were found, ſome of which had made their way through the ſurface, but the matter was confined by the adheſions ſurrounding the openings; they nearly occupied the whole of the right lobe: the quantity of matter taken out was full three pints: — there was no adheſion of the left lobe, nor appearance of inflammation on the ſurface, but upon cutting into it, a quantity of matter was found in the centre. — The omentum was of a browniſh colour, the veſſels in it very full, and on the lower part of the right ſide, ſome coagulable lymph was found, but no adheſion. — The ſpleen appeared ſound, but rather larger than common. — The ſtomach appeared, outwardly, without any marks of diſeaſe; in the inſide, ſome parts were of a deep red colour, particularly the poſterior part of the great curvature; it was alſo ſpotted with the ſame colour in different places. — The pylorus was in its natural ſtate, as well as the duodenum, except the latter having rather a greeniſh caſt; but the jejunum, and ilium, were of a dark brown colour, and in ſome places greeniſh: the internal villous coat of the ilium, was very dark coloured, and ſome coagulable lymph lay upon the outer ſurface.—The colon was of a greeniſh colour, particularly on the right ſide; towards the ſigmoid flexure, it became more of a natural colour.—The meſentery ſeemed to have been generally inflamed:—the kidneys and bladder perfectly ſound.—In the thorax, the lower part of the right lobe of the lungs, adhered very ſtrongly *to the diaphragm*, and *appeared to have been much inflamed*:—the left lobe was ſound, and without adheſion. A ſmall quantity of bloody ſerum was found on both ſides.

2. *Richard Clark*, ætat. thirty-eight, of a ſtrong healthy habit, was attacked on Tueſday, the 25th of June, 1787, with a diarrhœa, and pain in his bowels; this continued for at leaſt a week, without any other complaint.—He then complained of ſhooting pains in the right hypochondrium, extending acroſs the ſtomach: he had alſo ſome difficulty of breathing.—The pain in his bowels continued, but the diarrhœa diminiſhed:—ſtools dark coloured. A ſhort time afterwards he was bled, which gave him ſome relief.——On the 18th of July, he complained of conſiderable pain, with a

ſenſe of fulneſs and ſoreneſs, in the region of the liver: his breathing difficult, with ſome cough: he had alſo ſome difficulty in voiding his urine, with ſoreneſs and ſtiffneſs about his loins: — diarrhœa continued, though not very violent. — In a few days the pain abated; but there was conſiderable fulneſs and hardneſs in the region of the liver, with great ſoreneſs: his cough became more troubleſome; legs began to ſwell: — Dyſury continued, with ſmall ſecretion of urine, not very high coloured; but it became turbid, and ſettled upon ſtanding. — His head was rather painful and giddy; ſleep diſturbed, and ſkin much hotter: he could lie down in bed, without much ſhortneſs of breath, except on his left ſide. —— On the 23d, his fever was conſiderably encreaſed, he was very thirſty, and his tongue much furred. Cough and dyſpnea became worſe, with the fulneſs and ſoreneſs; the diarrhœa more troubleſome; and he ſweat very much in the night: pulſe quick and weak, and his legs much ſwelled. Dyſury continued. — Some days afterwards, he began to expectorate a browniſh matter, of a bitter-ſweet taſte. — On the 28th, ſome blood was voided in his ſtool; his pulſe was very quick, and his face much fluſhed: dyſpnea conſiderable, particularly upon motion, or lying down; the pain in the hypochondrium encreaſed, extending up the thorax to the right ſhoulder, and was ſometimes very acute; the ſoreneſs and fulneſs very great; the cough not ſo frequent, and but little expectoration; his tongue much furred and dry; ſleep diſturbed.—Theſe ſymptoms continued nearly the ſame, but with great increaſe of debility, till the 3d of Auguſt, when he died.

Appearances on Diſſection.

The right lobe of the liver adhered very much, on its convex ſurface, to the peritoneum; the left lobe was much enlarged, and covered all over with yellowiſh ſpots; there were ſome alſo on the under part of the right lobe: a large abſceſs was formed in the right lobe, occupying nearly the whole of it, which had ulcerated through the upper part of the convex ſurface; the opening was ſurrounded by adheſions to the diaphragm, through which the ulceration had continued into the under part of the right lobe of the lungs; this alſo was ſurrounded by adheſions.—A ſmall abſceſs was formed in the concave ſurface of the left lobe; the inſide was full of the ſame yellow ſpots obſerved on the convex ſurface.—The concave part of the right lobe, adhered much to the parts in contact, but was not ulcerated.—The omentum adhered conſiderably, both to the liver and peritoneum;—the colon was of a greeniſh colour:—the other inteſtines, and ſtomach, in their natural ſtate.——In the thorax:

on the right ſide, a large quantity of water was found, mixed with matter of a browniſh colour; this lobe of the lungs was covered with a cruſt of coagulable lymph, much collapſed, and adhered to the pleura, on the poſterior part, as well as to the diaphragm: thoſe parts of the pleura not adhering, were covered with a cruſt of coagulable lymph.—There was no fluid in the left cavity; and that lobe of the lungs perfectly ſound.—Some water was found in the pericardium; but the heart perfectly ſound.

X.

Two Caſes, communicated in a letter to the late Dr. John Fothergill, *London, by* James Johnſtone, *March* 20, 1758. — *Publiſhed in Medical Obſervations and Inquiries, by a Society of Phyſicians in London.* — *Vol.* ii. 1762.

Kidderminſter, Feb. 25, 1758.

Dear Sir,

AS I imagine the following caſes may not be inconſiſtent with the judicious plan the Medical Society have laid down for the improvement of their art, if you think my manner of drawing them up not improper, I beg leave, by your means, to ſubmit them to the diſpoſal of the Society; to whoſe laudable endeavours, I heartily wiſh all encouragement and ſucceſs. And am, with the greateſt eſteem and gratitude,

Sir,
Your much obliged,
and moſt humble Servant,
James Johnstone.

CASE I.

Mr. *B. W.* of Bromſgrove, a perſon of a habit of body, rather inclined to leanneſs, of a grave and thoughtful diſpoſition, and about ſixty years of age, had enjoyed a good ſtate of health: in his youth he had been laborious; of late years leſs ſo, though ſtill active; but at all times ſober, and regular in diet.

On the 23d of January, 1756, I was ſent for, and attended him. For a quarter of a year, and upwards, he had complained of want of appetite, with a weight, and obtuſe pain, about the lower orifice of the ſtomach: theſe complaints were ſtill rather increaſing, with great depreſſion of ſpirits, paleneſs, and bodily weakneſs. His pain, though never very acute, was ſometimes more ſevere than uſual, and might be conſiderably increaſed at any time, by preſſing upon the right *hypochondrium*, near the pit of the ſtomach. He complained alſo of acid, diſagreeable, bitter, and nauſeous belchings, for which his apothecary had given him a vomit, but without relieving him. His pulſe, in general regular and ſlow, ſometimes gave a few quicker ſtrokes, with ſome hardneſs. His urine was not pale, and was voided in ſmall quantities: his feet were cold; his ſkin dry. He took, by my directions, ſeveral medicines of the ant-acid, bitter, balſamic, and chalybeate kinds, with aloetics, and ſoap: from theſe he ſeemed at firſt to gain ſome relief, but that was very inconſiderable, and not laſting; for ſoon after, he was obſerved to become manifeſtly paler, weaker, and more emaciated. He then conſulted another phyſician, who, as I underſtood, had ordered him medicines of the ſame nature with thoſe he had taken by my directions, and with no better effect. He every day languiſhed more and more; at laſt became ſo weak, as to faint away upon the leaſt motion. About four months after I had been at firſt concerned for him, I was again called, and found his ſtrength and fleſh waſted exceedingly; yet he had undergone no conſiderable evacuation: he ſtill continued ſo coſtive, that no ſtools could be procured without glyſters: he had no ſweats; his urine was in proper quantity, and of a natural colour; he had ſlept all along tolerably well: he was pale to the laſt degree; ſometimes with a ſlight yellowneſs, which was not permanent: his pulſe was very ſlow; the pain at his ſtomach was now, in a great meaſure, gone; but his want of appetite, and nauſeous diſguſt to food, rather had increaſed. I ordered him to uſe only aſſes milk, with a little *magneſia alba*, and nouriſhing broths and jellies: by theſe his ſtrength was ſomewhat recruited, ſo that he could get out a little way in a chaiſe; and ſometimes his better ſpirits flattered him with hopes of recovery, but in vain! His loathing, and want of appetite, grew worſe; and his coſtiveneſs more obſtinate. In the beginning of Auguſt, 1756, he began firſt to complain of cholic pains in his bowels, from which he was a little relieved by emollient glyſters. About the middle of the month, he felt a ſharp pain at his ſtomach, and vomited up a great quantity of a chocolate coloured, turbid fluid, and died immediately.

He had taken nothing for a conſiderable time, which could be ſuppoſed to occaſion that turbid brown colour in the fluid he vomited up. All medicines, and moſt ſolid foods, from the beginning of his diſorder, to his death, cauſed more or leſs of a diſagreeable ſickneſs, and belching, for a long time after; but milk, broths, and ſoft liquids, agreed tolerably well with him, to the laſt.

Auguſt 20. His body, which was extremely emaciated, was opened by Mr. *Cooper*, ſurgeon; two more of his profeſſion, and myſelf, being preſent, with ſeveral other intelligent ſpectators. And the morbid appearances obſerved were the following:

1. After Mr. *Cooper* had laid open the *abdomen*, we perceived the ſtomach uncommonly large, and extended far beyond its uſual limits, for it covered

all the ſuperior part of the *abdomen*, from the *cartilago xiphoides*, to the navel, and its whole breadth from left to right: the *omentum* covered the remaining part of the *abdomen*, down to the *oſſa pubis.*

2. Upon raiſing the liver, we perceived the right orifice of the ſtomach drawn along with it, and connected to it, by a preternatural and ſtrong adheſion, tying the great lobe of the liver, to the curve of the ſtomach near the *pylorus:* upon applying the knife to this adheſion, it was found tough, hard, and white: in cutting it from the liver, we diſcovered an abſceſs contiguous to the liver and this ligament, containing ſome thick whitiſh yellow matter, like cream. In the ſame lobe, a little below this abſceſs, we obſerved a livid protuberance, of the ordinary ſize of a coat button; this being cut into, was found of a ſpongy texture, and contained ſome bloody water; the liver near this, was neither firm, nor very well coloured. The reſt of the liver was firm and ſound, but, as well as the gall-bladder, was ſomewhat larger than uſual.

3. The ſtomach, all about the *pylorus*, (whence the adheſion, No. 2, was extended to the liver,) had its coats and ſubſtance very much thickened with ſcirrhous knots, at leaſt an inch thick, which

made the external and internal ſurface of the adjacent part of the ſtomach, appear unequal and knotty; the internal ſurface, at this place, being ſqueezed, yielded a thick, ſlimy, and chalky coloured ſtuff, of a moſt fetid ſmell. Theſe ſcirrhous knots went round the whole circle of that part of the ſtomach, and yet had not entirely cloſed up the paſſage, which remained tolerably open for liquors both to paſs from the ſtomach into the *duodenum*, and for bile to regurgitate from the *duodenum* into the ſtomach.

4. The ſtomach contained near two quarts of a coffee coloured liquid, like nothing he had taken, but perfectly reſembling that which he had thrown up juſt before his death. It exceeded very much the quantity of any liquid given him for ſome time. The ſurface of the internal coat of the ſtomach was, in ſome places, diſcoloured with crimſon and livid ſpots, of the breadth of a ſixpence.

5. The cellular meſenteric membrane, which involves the beginning of the *duodenum* and the *colon* under the liver, was remarkably inflamed and coloured with blood. The end of the *pancreas*, next the *duodenum*, was very ſcirrhous. The *duodenum* contained much viſcid bile, of a dark brown colour. The ſmall guts were in various places diſtinguiſhed with livid ſpots. The great guts, (by

his long diſuſe of ſolid food, and the ſmall quantity of *fæces*, were reduced to the ſize of the ſmall guts.

6. The kidneys were large, but not unſound. The lungs of the left ſide adhered to the *pleura*, otherwiſe were perfectly ſound; as were likewiſe the heart and ſpleen. The great cavities of the breaſt and *abdomen* contained no water, except the uſual quantity in the *pericardium*. His body inwardly, as well as outwardly, was reduced to the laſt degree of leanneſs.

Upon the whole it is obſervable, that this diſorder, at firſt beginning with the appearances only of a common ſtomachic complaint, turned out a fatal Cardialgia Chronica, from the the ſcirrhous ſtate of the parts about the *pylorus*; and from putreſcence there, as well as from the abſceſſes in the liver. But a gangrenous ſeizure of the coats of the ſtomach and inteſtines, appears, by the laſt ſymptoms complained of by our patient, and by the morbid appearances, (No. 4, 5,) to have been the more immediate cauſe of his death.*

Few perſons from mere flatulency, acid eructations, want of appetite, and ſlight inconſtant pain at the ſtomach, would dread much danger: but as this hiſtory ſhows us, that inſuperable cauſes, beſides ſpaſm, relaxation, or foulneſs, ſometimes occaſion no other than theſe familiar ſymptoms, the greater ought our care and attention to be, in examining into the nature of diſeaſes, before we raſhly promiſe to ourſelves, or our patient, a cure, which it may not be in our power to perform.

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* A few ſimilar caſes have ſince occurred to me in the courſe of practice: they are generally unfortunate. The diſeaſe is carefully deſcribed by *De Haen*, Ratio Med. 6 part.

CASE II.

Opportunities of examining the bodies of perſons dying in the paroxyſm of an epilepſy, are not very frequent; yet from ſuch bodies it ſeems not unlikely that ſome light may be derived, to advance our knowledge of this diſorder, which, like many other diſeaſes of the brain and nerves, is not perfectly underſtood. In the ſummer of 1754, an accident, which had befallen the ſon of one *Harriſon*, in this place, a youth of about ten years of age, and the father's uncommon deſire of knowing the cauſe of his ſon's diſeaſe, gave me ſuch an opportunity.

The boy had been greatly troubled with epileptic fits, ever ſince he was two years old; and as they came on him without any external or known cauſe, they could be removed by none of the remedies which had been tried for his recovery. He had been blooded at leaſt three times; and his fits were, as the father told me, remarkably, more ſevere and frequent after theſe evacuations. He obſerved no other forerunner of the paroxyſm, beſides a pain in the *abdomen*; after which, the boy was uſed to fall down convulſed, and remain perfectly void of all ſenſation, till the paroxyſm was ended; after which, he would ſometimes doze a little; at other times, he would immediately be briſk and lively, and play, or eat, as if nothing had been the matter with him. Theſe fits had grown gradually more frequent; he hardly was ever free from them twenty-four hours: ſome days he was ſeized with ſeveral fits; and he had four fits the morning he died. In the laſt of theſe fits, it was ſuppoſed he had fallen down in a prone poſture, with his face ſunk a little into the mud of the common ſewer: in this ſituation he lay unobſerved, till he was perfectly ſuffocated.

His body and limbs were firm and plump; his hair brown. We found his hands as high as the wriſts, and his feet up to the ankles, of an intenſely livid colour. His face, and every other external part of his body, excepting the hands and feet, were pale, as uſual in dead bodies.

Having opened the *abdomen*, the contents thereof ſeemed ſound; only his ſtomach and bowels were rather of a higher red colour than is uſual, yet not inflamed. No worms were found in ſlitting up the inteſtinal tube, nor could I learn that he had voided any.

In his breaſt, we obſerved his lungs of their natural colour, ſpongy, and neither ſtuffed with blood, water, or *pus*. We were ſurprized to find much leſs blood than is uſual, in the trunks of the *cava aſcendens* and *deſcendens*, and in the right auricle and ventricle of the heart; and much more than is uſual, in the left ventricle of the heart, and in the *aorta*. For here, where there is commonly little or none, we found nearly as much as in the right ventricle and *cava*.

The ſutures of the *cranium* were cloſe, and much leſs viſible than is uſual at the age of ten years. The longitudinal and lateral *ſinuſes* of the brain, were almoſt quite empty of blood. The veſſels, ramified upon the ſurface of the brain and *pia mater*, were prodigiouſly fuller, and more diſtended with blood, than I had before obſerved in any other diſſection: and the drops of blood, which came out in great numbers upon cutting into the ſubſtance of the brain, were alſo larger than uſual. An ounce and a half of water was found in the ventricles of the brain; and a ſmall hydatide, like a piſtol bullet, adhered to the *plexus* *choroeides*: the veſſels of this part were likewiſe much diſtended with blood.

Theſe were the only morbid *phænomena*, which were taken notice of in this body; and as theſe ſeem to afford ſome uſeful inferences, I beg leave to propoſe the following.

In the whole narrative, nothing is more remarkable, than the fulneſs of the arteries, which, in moſt dead ſubjects, are generally found empty of blood, and pale, and contracted. This fulneſs of the arteries ſeems to have extended to their ſmalleſt ramifications; not only in the extremities, which were livid, but alſo in the ſubſtance of the brain itſelf, the ſmall veſſels were obſerved very full of red blood; and it is moſt probable, that theſe veſſels were not veins, but arteries; ſeeing the large *ſinuſes* of the brain were entirely empty: and *ut majora ita minora vaſa*, ſeems a maxim which may, in the preſent caſe, be depended upon. It is ſome years ſince I was informed, by my learned friend Dr. *Short*, that he had known hæmorrhages produced from the ſurface of the body, by the confinement of the blood in the arteries: and, which is more extraordinary, the left ventricle of the heart burſt, and the blood poured into the *pericardium* and *thorax*, from the violence of the epileptic paroxyſm. In a word, this fulneſs ſeems to be the real ſtate of the arteries in the epileptic fit, whether ariſing from the preſſure of the convulſed muſcles, or, which is moſt likely, proceeding from an univerſal ſpaſm, or conſtriction of the *arteriolæ minimæ*. And this effect proceeding as a conſequence from the ſame primary unknown alteration in the brain, and its productions the nerves, which occaſions the epileptic convulſions, will enable us not only to explain ſymptoms, but, which is more eſſential, will ſerve for a guide, by which our practice may be regulated, eſpecially during the violence of the paroxyſm. And ſurely, if any evacuation of blood be requiſite, venæſection ought not to take place. The confinement of blood in the arteries, requires arteriotomy, or cupping, with ſcarification. Frictions, and above all, proper antiſpaſmodics, both externally and internally.

XI.

Caſes of HYDROPHOBIA. *Communicated by* James Johnſtone, M. D. C. M. S. S. R. M. ED. S. *Phyſician to the General Infirmary of Worceſter; Member of the Philoſophicol and Literary Society of Mancheſter. With Reflections on the Prevention and Treatment of perſons bitten by mad and hydrophobic animals.*[*]

Read November 21, 1785,
To the Medical Society, London.

CASE I.

GEORGE POLLOCK, aged forty-five years, by trade a blackſmith, was admitted the 5th of March, 1750, a patient of the Royal Infirmary, at Edinburgh: about the end of November, he had been bit by a mad dog, on each ſide his left leg, a little above the ankle; the wounds bled freely, and were waſhed with common ſpirits immediately: the next day he was bled, and bathed the ſores in ſalt water, and, in about thirty hours after the accident, put himſelf under the care of Dr. *Dundas*, at that time a phyſician of conſiderable practice, in Edinburgh, who ordered ſixteen ounces of blood to be taken from the arm, and the following bolus, two of which were taken each of the two ſucceeding days, without producing any very ſenſible effect.

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[*] See Med. Memoirs, vol. i.

R. Cinnab. nativ. Cinn. factit. aa. gr. xxiv.
Moſch. gr. xv. ſyr. ſacch. q. s. f. bolus.

He was then ordered to take a drachm and half of the *pulvis antilyſſus*, every morning, in a little milk, for four mornings, to uſe the cold bath forty days ſucceſſively, and to dreſs the ſores with mercurial ointment.

He omitted, however, the cold bath the laſt eight days; and latterly, the ulcers were dreſſed with *unguentum baſilicon*, inſtead of *unguentum mercuriale*: by theſe means the ſores were kept open for a month, or upwards: he had no pain from them; but the matter diſcharged was always thin, and ſanious, and at no time good *pus*. However, he made no complaint till the 3d of March, in the afternoon of which day, he felt a pain and weakneſs about the loins, *os ſacrum*, thighs, and falſe ribs, attended with heat, and ſharp pain in making water; next day he complained of ſharp pain in the abdomen, and about eight o'clock in the morning, began to have that averſion and difficulty in ſwallowing liquids, which afterwards increaſed extremely; ſo that when admitted into the hoſpital, he could not attempt to drink any thing, without a moſt dreadful effort: the attempt always occaſioning his fetching deep ſighs, and being affected with an univerſal horror, and ſuch violent ſpaſms in the organs of deglutition, as almoſt endangered his being choaked; yet, at no other time did he complain of any pain about his throat, or of heat there, and ſwallowed bread, and ſolid food, without any difficulty; his other pains grew every hour more ſevere, and they are increaſed conſtantly when he endeavours to drink: he ſaid he would willingly drink, did not ſomething, which he cannot deſcribe, render the thought and ſight of liquids diſagreeable; and an attempt to take, and ſwallow them, an inſuperable difficulty, and a violence which he cannot account for. He has not ſlept for forty-eight hours; his tongue is white and dry; his urine ſmall in quantity, but high coloured; regular in ſtools; his pulſe feveriſh and hard, and not much altered by his attempts to ſwallow liquids.

Dr. *Rutherford*, profeſſor of medicine, and, at the time, clinical lecturer, being much attached to the doctrines of *Boerhaave*, determined to try the antiphlogiſtic method in this caſe; and ordered the patient, who had been bleeded in the morning, to loſe gradually, the large quantity of ſixty-ſix ounces more: from this evacuation he became ſick, and a little faint, and his pulſe ſomewhat ſmaller and ſlower; though by no means in proportion to the quantity of blood he had loſt. The blood was not ſizy, but abounded with ſerum; the *craſſamentum*, of a florid, ſcarlet colour, and its texture looſe, like the blood of hyſteric women. The Doctor alſo ordered his head to be ſhaved, and often embrocated with equal parts of vinegar and water; and a ſlice of lemon, with ſugar upon it, often to be given him. Alſo,

R. Rad. Gramin. unc. ii. fruct. tamarind. unc. i. coque ex Aq. font. lb. iii. ad lb. ii. ſub finem addendo.

Rad. liquorit, unc. ſs. Colaturæ cap. unc. ii. omni ſemi hora.

R. Sal. nitri pulv. drach. ii. Divide in doſes vi. cap. unam omni bihorio in hauſtu decocti.

R. Decoct. commun. lb. i. Mellis, unc. i. Sal. nitri, drach. ii. m. pro enemate omni quarta hora injiciendo.

He was ordered panada for his food.

Eight o'clock at night. The glyſter brought away indurated *fæces*, in fifteen minutes after it was injected. Has taken four doſes of the decoction, and ſome panada. His urine high coloured, drops ſome ſediment; the pulſe beats about ninety-eight ſtrokes in a minute; his pains, and heat in making water, are leſſened, but his averſion and horror to liquids are undiminiſhed.

The Profeſſor ordered the medicines already preſcribed to be continued, and to take, after bathing his feet, the following draught.

R. Syr. diacodii, unc. i. repetendam intra ſpatium trium horarum, ſi opus ſit.

R. Spir. vitriol. dulc. unc. ſs. cap. gutt. xxx. ſæpius cum potu communi.

Tueſday, March 6, at ſix o'clock in the morning. Laſt night, about nine o'clock, the injection was thrown in, and his feet afterwards bathed, from which a clammy ſweat followed: for, the noiſe of the water, made by his feet, made him ſhiver, ſigh often, and look wild about him. His pulſe, at the time, beat 115 ſtrokes in a minute, with an unuſual tremor in it. His urine, made in the night, paler: he had two clyſters, and two anodyne draughts, after which he ſlept two hours at different times; being pretty free from pain, unleſs when urged to drink, at which time, pains in the belly, beginning at the pit of the ſtomach, came on, and were attended with frequent ſighings, and violent convulſions. Directions were punctually obſerved. In giving drink, it was remarkable, that he always took a ſecond or third draught, with leſs reluctance than the firſt, and, therefore, two or three draughts were commonly given him ſucceſſively.

Eleven o'clock. The *pediluvium* produced an hour's ſleep, and his pulſe roſe: his pain in making water gone, but *Hydrophobia* increaſed: he cannot take any liquid, and has an extreme averſion to any thing which looks like a fluid, or in which any fluid has been contained; but, when his eyes are ſhut, or covered, he can ſtill drink.

Seven o'clock at night. He complains of a ſtounding pain, as he calls it, in his belly and ſmall of his back; which is moſt acute on moving, or ſitting up, in his bed. When he drinks, which he never does without horror and convulſion, he feels a ſtinging pain in his ſtomach, but none in his mouth or throat. Immediately after drinking, he ſweats about his head and breaſt, with vehement efforts to vomit, though nothing comes up. His pulſe hard, beats 104 ſtrokes in a minute; his tongue white and foul, fauces red, urine pale: he had a clyſter, which operated twice, but brought away nothing but ſlime; his hands cold.

Ten o'clock at night. He goes on as before directed; attempts to drink with the ſame reluctance, horror, and convulſive motions, with deep ſighings; and after theſe, retchings, vomiting, increaſed quickneſs of pulſe, and return of pain. He ſpits *ſaliva* with great quickneſs, and with averſion. If it falls on his hand, he, as quickly, wipes it off, yet does not complain that it taſtes amiſs. He never offers to ſpit upon, or moleſt any one. He ſometimes ſlumbers for a few minutes, but it is interrupted by deep ſighs and convulſions. His pulſe, after bathing, roſe to 120 ſtrokes in a minute; though it has continued generally at 100 ſtrokes, with interruptions. He voided an ounce of turbid urine, and took panada with the uſual reluctance, and a doſe of ſyr. de mecon. after which he ſlept half an hour.

Wedneſday, March 7, eight o'clock in the morning. He was quite delirious betwixt ſix and ſeven, but is now pretty ſenſible. He makes ſtrong efforts to drink, though now for the moſt part ineffectually.

Eleven o'clock in the forenoon. Theſe efforts to drink, always produce belchings, retchings to vomit, and pains, which begin in the lower region of his belly, and ſqueeze every thing upwards towards his ſtomach, attended with convulſions and deep drawn ſighs. His eyes are diſmally wild, red, and inflamed: talks much concerning his wife and family, with great affection; ſpeaks in a religious ſtrain, and ſays he is dying. Pulſe quick, but very weak and intermitting. He has had two boluſſes. R. Moſch. pulv. ſcrup. ſs. Conſ. Roſar. q. ſ. f. bolus. Continue them every hour, and, as he cannot ſwallow any thing liquid, let the clyſters and embrocation be uſed the oftner. R. Sal. nitr. ſucchar. alb. aa. p. æ. redige in pulv. a little of this to be given frequently.

Four o'clock in the afternoon. He had a muſk bolus about one o'clock, and opii. gr. ii. was offered, which he could not ſwallow. In ſpite of every effort to relieve him, the ſymptoms of death approach, with intermitting pulſe, cold ſweats, cold extremities; and in attempting to drink with his uſual courage, he was violently convulſed, the liquor, as in one choaked, regurgitated back through his noſtrils, he fetched a deep ſigh, reclined his head, and expired. He never had been furious, or in the leaſt inclined to offer violence or miſchief to any one; on the contrary, he was ſomewhat anxious leſt he ſhould be the occaſion of it. A looking-glaſs was frequently held before him, but it never diſcompoſed him in the leaſt.

Next day his body was opened by Mr. *G. Lauder*, at that time a celebrated ſurgeon in Edinburgh. The ſtomach was much contracted in its ordinary ſize; and contained nothing. The ſmall guts ſeemed ſound, only the *ilium* ſeemed a little inflamed, and a few livid ſpots were ſeen upon it. The ſac of the colon was near as large as an ordinary perſon's head, and, beſides air, contained a large quantity of fæces. It was obſerved, that the inteſtines were much out of their uſual ſituation and order. The liver appeared a little livid; the gall-bladder much diſtended with bile, which tinged very conſiderably the adjacent parts of the colon and *omentum*. Nothing unuſual was obſerved in the contents of the thorax: and the further examination of the larynx and pharynx, and the opening of the *cranium*, were prevented, by the ſurgeon's finger being accidentally cut, which made it improper for him to proceed.

Dr. *Rutherford*, at that time profeſſor of the practice of phyſic, and clinical lecturer, long celebrated as an able practitioner, as well as teacher of medicine, in Edinburgh, attended this patient, with the moſt anxious and humane care: and in the lecture which he gave on the caſe, he candidly retracted an opinion, which he had learned from *Boerhaave*, and which had directed the meaſures he took. he ſaid, he was convinced now, that the *Hydrophobia* is a ſpaſmodic, and not a high inflammatory diſeaſe. That, though bleeding may be uſeful, in preventing furiouſneſs, neither that, nor the proper antiphlogiſtic method, are to be depended upon, as the proper cure of the *Hydrophobia*: that in ſuch caſes, after bleeding once or twice, he would order ſal ſuccini muſk, and opium; and, perhaps, bliſters. He thought bathing, and other prophylactics, ſhould never be neglected; but profeſſed no great confidence in the *Pulvis Antilyſſus*, which had, about that time, been warmly recommended by Dr. *Mead*, but which, I believe, has ſince fallen into diſuſe.

This caſe may be found recorded in the books of the Royal Infirmary, at Edinburgh; but having been an attentive obſerver of the whole courſe of the illneſs, I have given it from my notes taken at the time.

Worceſter, Oct. 24, 1785.

CASE II.

By Edward Johnſtone, M. D. *Phyſician to the General-Hoſpital, in Birmingham, and Fellow of the Royal Society, at Edinburgh.*

AUGUST 16, 1784, I was ſent for to *Charles Bullock*, of Weſt-Bromwich, a fine lively boy, aged four years, of a ſtrong vigorous habit of body. On Friday, the 9th of July, he was bit on the right cheek, and juſt under and above the right eye, by a mad dog. The wounds were ſmall, bled little, and ſoon healed, leaving only a ſlight mark on the cheek, and a ſcar under the eye. The next day he began the uſe of the Ormſkirk medicine, which he took in the manner directed in the paper given with it; and ſome of the powder, mixed with a little digeſtive, was applied to the wounds. He ſeemed to enjoy his uſual health and ſpirits, till the 15th of Auguſt, except that about a fortnight* before that time, he was one afternoon very dull, and paſſed a reſtleſs night, but was as well as uſual the next day. On the morning of the 15th, he appeared very low and ſpiritleſs, had little appetite, his breath was obſerved to be very offenſive, and he complained of a pain, ſhooting from the part where he had been bitten, to the teeth. He had a very reſtleſs night; and early in the morning of the 16th, Mr. *Beardmore*, an eminent ſurgeon and apothecary, was called to him, who immediately deſired aſſiſtance.

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* His father ſaid at the full of the moon, though he did not appear to be certain of it.

I ſaw him about twelve o'clock, when he was walking about a room, in which a number of people were collected, with an appearance of great anxiety and horror, and a peculiarly fierce look; he ſtarted on my entering, and expreſſed great apprehenſions of being ſent to the ſalt waters; but was much compoſed and pleaſed, on my aſſuring him he ſhould not go there. I then deſired him to drink ſome ſmall beer; he immediately turned away, changed colour, expreſſed the greateſt horror and averſion, and was ſeized with a catching of his breath, and convulſive motions of the muſcles about the throat;* but upon its being removed, ſoon recovered his uſual compoſure, and, without difficulty, eat ſome bread and butter. A baſon of water was afterwards brought in, without his perceiving it at firſt; but as ſoon as he caſt his eye that way, he ſhewed great uneaſineſs, and upon

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* The ſame ſymptoms were likewiſe brought on, by his being expoſed to a ſtream of air.

putting his hands into it, was immediately ſeized with univerſal tremor, and convulſive motions of the muſcles about the throat, attended by a kind of ſobbing, half reſpiration, and ſuch an inexpreſſible anxiety, and gloomy horror of countenance, ſuch a fierce ſcowling look of the eyes, as no language can give an adequate idea of, but which, if once ſeen, can never afterwards be miſtaken.

The diſorder being too clearly aſcertained, I ordered him to be put into a warm bath, which was done ſuddenly; but univerſal convulſions immediately took place, attended with an appearance of ſuffocation, which laſted ſome ſeconds: his breathing gradually returned, with a noiſe ſimilar to that uttered during each cough in the chincough, or in the croup, and he, at the ſame time, rejected a conſiderable quantity of viſcid frothy matter. Being fully perſuaded of the miſchief of this practice, I directed a bolus, compoſed of tart. emetic. op. pur. aa. gr. ſs. Moſch. gr. vi. to be given immediately, and to be repeated every hour; and the following injection to be adminiſtered every three hours.

R. Aſafœtid. unc. ſs. ſolve aq. puleg. unc. vi. tinctur. thebaic. drach. ii. muc. gum. Arabic. unc. ii. M.

R. Miſtur. præcedent. unc. ii. juſcul. ovin. unc. iv. M. Fiat. enema.

Unguent. mercur. fort. to be rubbed into the lower part of the face, near the wound, round the neck, and other parts of the body, as often, and in as large quantity, as poſſible.

In the evening he ſeemed much better, and on being aſked to take ſome tea, with great reſolution, though with difficulty, ſwallowed a ſpoonful, which immediately brought on the ſame ſymptoms as before. I ſaw him by ſix o'clock of the morning on the 17th; he had paſſed a very reſtleſs night, the recumbent poſture always bringing on the paroxyſms of the diſorder. He had only taken two boluſſes, but the glyſters had been given regularly, and ſtaid up; and a very conſiderable quantity of mercurial ointment, had been rubbed in. His pulſe was much weaker than before, and very fluttering and variable. Upon endeavouring to walk, he reeled conſiderably, and was almoſt conſtantly endeavouring to ſpit out the frothy viſcid *ſaliva*, which ſeemed very troubleſome to him.* Upon being deſired to eat ſome bread and butter, he took it into his mouth, but immediately ſpit it out, and ſeemed to be in great agony. I directed four ounces of the mixture, with aſafœtid. and tinct. thebaic. to be injected as before, and half a grain of crude opium, to be given him every half hour, if it could be got down; a bliſter to be applied to the nape of the neck, and mercurial ointment to be uſed as before. He only took two doſes of the opium.

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* It is remarkable, that he was anxious leſt the *ſaliva* ſhould fall upon thoſe about him, and frequently deſired them to get out of his way, when he was going to ſpit.

About eleven o'clock, he was ſeized with violent convulſions, particularly about the muſcles of the throat, but affecting moſt of the other muſcles of the body, during which, he ſnatched at thoſe who were near him, and made a noiſe like a perſon ſuffocating: this fit laſted near half an hour; and afterwards, he was perfectly exhauſted for ſome time, and fell into a cold clammy ſweat. Theſe convulſive fits, alternating with fainting ones, continued, with very ſhort intervals, till four o'clock in the afternoon, when he expired.

Reflections on the Prevention and Treatment of Perſons bitten by mad and hydrophobic Animals. *By* James Johnſtone, M. D. &c. &c. &c.

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1. I BEG leave to add ſome Reflections to theſe caſes. The firſt caſe forms a kind of epoch in the treatment of the *Hydrophobia*, which is now univerſally acknowledged and treated as a convulſive diſeaſe, not without ſome hopes of ſucceſs, if we may credit *Sanvage*, and other French writers of reputation; alſo the caſe treated ſucceſsfully by Dr. *Nugent*; and one or two more, related in the Medical Tranſactions of the College, and in the Memoirs of the Medical Society of London.*

2. *Hydrophobia*, or an averſion and horror to liquids, is its true definition. A rabies, with a miſchievous deſire of biting, (ſee defin. *Linn.*) is, in man, I believe, ſeldom an uſual, much leſs a conſtant ſymptom, in this diſeaſe. This averſion, or horror, is produced in the mind, by the action of the poiſon on the nerves, which occaſions ſpaſms in the throat, remarkably aggravated by every attempt to ſwallow liquids in particular, and accom-

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* Vol, iii, p. 454.

panied with various ſpaſmodic pains about the *præcordia*; which are excited, and, in every part, increaſed, by the appearance, ſound, and touch of any fluid. It is then a ſpaſmodic *angina*; and the averſion to ſwallow may, in part, be an averſion to pain: but other *angina's* are painful, without this horror: I therefore conclude that, in the *Hydrophobia*, it partakes of delirium.

3. The attempting to conquer this averſion to the ſwallowing of liquids, produces dreadful, and, finally, fatal ſpaſms: in the firſt inſtance, in the pharynx; perhaps from the ſalival liquors being peculiarly tainted with the poiſon: alſo the *æſophagus* and ſtomach, and all the parts in the abdomen furniſhed with nerves from the ſplanchnic nerves, and from that great centre of nervous ſympathy and action, the great ſemi-lunar ganglion, called by ſome, *cerebrum abdominale:* which convulſions, in their continuance and progreſs, diſturb the natural and vital functions, and, finally, arreſt the motion of the heart.

4. During the *Hydrophobia*, the ſalival liquors, and thoſe, perhaps, which lubricate the *æſophagus* and *primæ viæ*, being ſtrongly impregnated with this fatal poiſon, may not the abhorrence of fluids, which characteriſes the diſeaſe, and which makes the ſwallowing of them ſo dreadful, be owing to

the baneful ſtimulus of venemous *ſaliva*, on the nervous and irritable ſurface of the *fauces* and *primæ viæ?* And are not theſe ſpaſms efforts, however ineffectual, of irritability, and the principle of life, to throw off this poiſon? It is certain, that antimony, and many vegetable poiſons, are deleterious and fatal, as well as the poiſon of the viper and mad dog, though not diſcernible by taſte.

5. Reſpecting the treatment of this poiſon, and ſuch as are unfortunately likely to ſuffer by it, I apprehend the ſureſt preventive is, (after wiping off, and waſhing it away as much as can be done,) to cut away, or ſcarify the bitten part immediately, and to deſtroy it by cauſtic, or actual cautery. (See here the method of *M. Le Roux*, Appendix.) This is to be done as early as poſſible, and beyond the depth and extent of the bite. If all this be done immediately, and no particle of the venemous *ſaliva* be left in the wound, the patient, by this operation, and by ſuppuration kept up for two months, by digeſtive ointments, armed with red *præcipitate*, will be in perfect ſecurity.*

At whatever time afterwards medical aſſiſtance is called for, the ſame local treatment is to be enjoined:

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* The misfortune of *M. Rowley*, ſhews this external treatment, even when early performed, by a very able ſurgeon, does not give abſolute ſecurity; and that other means of prevention deſerve attention.

joined: and it is not to be omitted, even when ſymptoms of *Hydrophobia* are threatened, or appear; as the hiſtory of the diſeaſe ſhews, that the ſpaſms which affect the throat, generally ariſe from the bitten part.

But this prophylaxis, though never to be neglected, cannot be ſuppoſed, and, in experience, has not been found, to give the ſame conſtant ſecurity, which it affords when done inſtantly after the bite. In ſuch circumſtances, the prophylactics which have been found moſt uſeful in preventing the progreſs and virulent effects of this poiſon, on the blood and nervous ſyſtem, muſt be had recourſe to.

6. Mercury has been found, in extenſive experience, to be a very effectual preventive of *Hydrophobia*, and, in ſome inſtances, has aſſiſted conſiderably in curing it: in the diſcreet application of this antidote, both externally and internally, and in adding thereto the antiſpaſmodics and tonics, Peruvian bark, Valerian root, muſk, and opium, the phyſician will probably give ſecurity to his patient, in moſt inſtances, if not in all.

The uſual courſe which this poiſon takes, indicates the application of mercury to the bitten part, by applying it there, and by rubbing it around it;

and alſo to the *fauces*, where it will mix with the *ſaliva* and *mucus* in the pharynx, *æſophagus*, and *primæ viæ*, and obviate the tendency of the poiſon, in its moſt deſtructive courſe and period.

But the quantity of theſe mercurial adminiſtrations, muſt never be ſo great, as to excite a copious ſalivation, or conſiderably weaken or diſturb the body.

In an adult, half a drachm of ſtrong ointment, charged with camphire, ſhould be applied to, and rubbed near the wound, daily.

And two grains of calomel ought to be rubbed every evening within the mouth, enjoining the patient to ſwallow his ſpittle for ſome time afterwards: in this way, it will mix with the *ſaliva*, and paſs through the whole courſe of *primæ viæ*; and, while it keeps the body open, will, in a ſmall quantity, mix with the lymph and blood; and without diſturbance or loſs of ſtrength, will meet and correct the poiſon, if it enters the habit.

In very young patients, and delicate ones, the quantity may be diminiſhed; or, in ſtronger ones, increaſed.

After a fortnight, the calomel ſhould be intermitted,

mitted, and a cathartic given, and an opiate in the evening, after the cathartic.

In ten days time, the calomel ſhould be reſumed for another fortnight, followed with a purge and opiate, and intermitted once more for ten or twelve days, after which it may be again uſed a fortnight, in the ſame manner, and then, if no ſymptoms appear, the uſe of mercury may be laid aſide, and the patient's ſafety preſumed upon.

If the patient's reſt be diſturbed, or any dejection, hurry, or melancholy appears, he ought to uſe, while this courſe is going on, muſk, opium, aſafœtida, and a drachm of an electuary of P. cort. Peruv. Valerian. aa p. æ. twice in the day, as occaſion requires.

If any tendency to *Hydrophobia* appears, the doſe of calomel, or quantity of mercurial unction, ſhould be continued, and greatly increaſed: and a ſalivation raiſed as expeditiouſly as poſſible, by a cinnabar fumigation.

Emetics of turbith mineral, have been found of great uſe in preventing *Hydrophobia*, and certainly ought to be repeatedly given, with opiates afterwards, to allay the hurry of nerves, if any of the forerunning ſymptoms of *Hydrophobia* appear.

Emetics, even of milder operation, as well as the turbith, muſt be highly uſeful, by evacuating the *ſaliva* and ſlime, if at all tainted, from the throat and ſtomach.

Hurry of nerves, ariſing from the remedies or the diſeaſe, require great attention; and muſt be removed by muſk and opium. To diſpel anxious fear, and to ſupport hope and chearfulneſs, are indiſpenſibly neceſſary in preventing *Hydrophobia.*

Theſe are the means of prevention and cure I ſhall purſue when occaſions offer; they will not always ſucceed, but I know no better; and none ſo much ſupported by experience and authority, or ſo cloſely connected with the real phænomena of the diſeaſe. In every diſeaſe, the beſt founded methods are ſometimes unſucceſsful: but to this, above all others, the introductory aphoriſm of *Hippocrates*, has the juſteſt application: — *Occaſio Præceps*, &c.

APPENDIX.

I PROPOSE to give here, a ſhort view of the methods recommended in the ingenious papers publiſhed in the ſecond part of the Hiſtory and Memoirs of the Royal Society of Medicine, at Paris, 1783, on the ſubject of canine madneſs.

The following is the method recommended by *M. Le Roux.* Having diſcovered the direction and full dimenſions of the part bitten, by the mad animal, the wound muſt be dilated with a biſtory round its whole circumference, and a croſs, ſtar-like, to make the ſurface larger than the bottom of the wound. The tendons, and larger veſſels, are to be avoided as much as poſſible, in making theſe inciſions. The wound is to be allowed to bleed freely, and to be waſhed with ſoap-water, or, the part is to be dipped in a bath of it, and then to be dried with lint, and covered till the next day. After removing the firſt dreſſing, a ſkewer of wood, dipped in deliqueſcent butter of antimony, is to be made to touch every part of the wound, particularly the bottoms and edges thereof, and even the ſurrounding ſkin. Every part touched with this cauſtic, becomes immediately white, and burnt to a greater depth, even of ſome lines. A bliſtering plaſter is then applied over the wound, and widely beyond it, and this finiſhes the ſecond dreſſing. *M. Le Roux*, does not apply the liquid butter of antimony the firſt dreſſing, becauſe the blood would dilute and præcipitate the cauſtic, into a kind of powder of algaroth, which is not cauſtic. He prefers the potential cauſtic, to the actual cautery, becauſe it gives leſs terror and pain, and burns more preciſely to the deſired depth, and the eſcars are ſooner ſeparated. He has only twice met with wounds in parts dangerous to be burnt; yet he repented afterwards his tenderneſs, as both the patients died of Hydrophobia: when ſo ſerious a malady is to be feared, ſacrifices muſt be made, and he will not avoid them in future. The bliſters are cut and dreſſed the next day, and freſh butter applied to the wound, till the eſcar falls off, which happens in a week: after this, the wound is kept open in abundant ſuppuration, by putting in ſeveral peas, or gentian root, of a ſize proportioned to that of the wound. As the fleſh ſprings up, it is to be burnt again with the butter of antimony, and freſh bliſters are again and again applied; for the wound muſt not be allowed to heal till after forty days. By this method alone, he ſecures his patients, and gives no other internal remedy, except a few drops of ſpir. vol. alcalin. and not that always.

M. Baudot is perſuaded, that the effects of the bite, however extenſive they may become, proceed from the action of the poiſon on the part originally bitten only. After cleanſing and waſhing the part with ſalt water, he applies a bliſtering plaſter, which covers the wound, and extends conſiderably beyond it: he afterwards rubs mercurial ointment, with the addition of camphor, very plentifully all around the bitten part, and over it; to theſe he adds bathings, and frictions with warm oil: this treatment is continued fifteen or twenty days, by which means only, he believes the mercury deſtroys the *virus* fixed on the nerves in the wounded part, and, that the oil, in relaxing theſe parts, aſſiſts in hindering the ulterior propagation of thoſe ſpaſms, which would otherwiſe have extended their action to the ſalivary glands, and have excited *Hydrophobia*. A very great number of atteſted câſes are produced, in ſupport of the efficacy of this preventive method. If he be called to ſuch as have not been early treated in this manner, and who are threatened by ſymptoms of *Hydrophobia*, he orders ſcarifications, in addition to the former method, with bleeding, nitre in apozems, opium, and other antiſpaſmodics. His ſucceſs was very conſiderable in every ſtage of the diſeaſe, the actual *Hydrophobia* excepted, which proved always irreſiſtibly fatal.

M. Bouteille, in a very methodical and well-written eſſay, agrees nearly in approving the ſame mild local treatment as *M. Baudot*, by ablutions and bliſters; yet recommends alſo ſcarifications and cautery, when ſtrictly neceſſary. He is alſo high in the commendation of mercurial ointment, rubbed daily near the wound, and applied to it; which, in his opinion, both draws out the poiſon from the wound, and corrects it, (61,) and, at the ſame time, eaſes the ſpaſmodic pains ariſing from the virulence of the poiſon: but thinks a mercurial ſalivation, both ineffectual and pernicious. If the wound be cicatrized, when ſymptoms of *Hydrophobia* appear, he, in that emergency, recommends the application of cauſtic, or actual cautery, to the part, to open an external paſſage to the poiſon, which he preſumes to be be ſtill acting there.

The mercurial method of preventing *Hydrophobia*, which had been cenſured as uncertain, and, in ſome caſes, hurtful, by *M. Le Roux*, is very warmly adopted and recommended by Meſſ. *Baudot* and *Bouteille*, though on different principles; and ſo as to ſhun exciting ſalivation, which had been a mode in France, after *M. Sauvage* had publiſhed his ingenious Diſſertation ſur la Rage.

Thiſ mercurial method is the only one depended upon and recommended, in the Memoir of *M. Bonel*, de la Blagereſſe, who truſts entirely to mercurial frictions, and to laxative mercurial pills, to be continued for about three weeks; and occaſionally to be purged off by an increaſed doſe of the pills, ſo that ſalivation may be obviated: he applies to the wound mercurial ointment only. He treated five hundred patients in this method, without a ſingle miſcarriage; and believes the ſame medicines, in double or triple doſes, with the addition of muſk, and other antiſpaſmodics, to be an effectual cure in the *Hydrophobia* itſelf: of which he has no hiſtory to produce, as he had conſtantly ſucceeded by his preventive method.

M. Mathieu, maitre en Chirurgie, in Perigorde, after bleeding and purging, depends altogether on copious mercurial frictions, to excite ſalivation, unleſs the mercury occaſions ſome other evacuation, which will ſupply its place. He ſays, the *Hydrophobia* yields, as it were, by enchantment, when the ſalivation appears; and it muſt be kept up, more or leſs, according to the degree of the diſeaſe, and ſtrength of the patient.

Many inſtances have been produced in the courſe of theſe Memoirs, in which individuals were ſeized with, and carried off by, *Hydrophobia*, notwithſtanding mercury had been very early and amply uſed, even to ſalivation: be it ſo; but this does not invalidate other reſpectable teſtimonies, that in a prodigious number of inſtances *Hydrophobia* had been prevented, and in others, cured by it. Hear the reſpectable *Sauvage*, who concludes a maſterly work in the following words: "Apres bien de "recherches, I' ignore que ce remede ait encore "manque, etant, meme applique quand la Rage "etoit declaree." How few infallible remedies can we boaſt of in other diſeaſes! Shall we then quit this ſingle anchor, becauſe it has failed, as others have done before, though it is granted to have ſucceeded ſometimes?

D. Metzlar, a German phyſician, in a very elegant and learned Latin diſſertation, the laſt publiſhed in this volume, on the prevention and cure of *Hydrophobia*, concludes thus: "Haud aliud in "terribili hoc morbo, habetur remedium quam "mediante ferro inſtituta Inuſtio."

To this opinion, the Royal Society of Medicine ſeem indirectly to have added their reſpectable authority, by crowning the Memoir of *M. Le Roux*, with their firſt prize; their ſecond being ſhared betwixt Meſſ. *Baudot* and *Bouteille*, for their ingenious Memoirs, and by their poſitive declaration, that the external treatment, which conſiſts in deſtroying the part into which the *virus* is infuſed, is indiſpenſible, and the moſt important, without which, all the other proceedings are uncertain; and, that among theſe laſt, ſuch as diſorder the animal œconomy, or ſtrongly affect the nerves, expoſe the patient to more or leſs danger. (*Hiſt. de la Med.* p. 2.)

Happy will it be, if this indeciſion reſpecting internal remedies, excite an early and cautious care of the unfortunate objects of theſe Memoirs; and alſo, make the practitioners of the healing art more ſucceſsful in their future applications, and, in the mean time, diligent in the uſe of the beſt means already diſcovered.

Worceſter, *Dec.* 24, 1785.

XII.

Additional Caſe of HYDROPHOBIA.

THE 7th of Auguſt, 1788, I was requeſted to attend Mr. *John Taylor*, aged fifty-five, a farmer, at Burcot, near Bromſgrove: about four months before, he was bit in the right wriſt, by a mad dog; for which, he had taken for three weeks powders of cinnabar, and, Æthiop's mineral; and was dipt or bathed, in the uſual manner, in ſea-water.

2d of Auguſt. Saturday. Unwell, and ſymptoms of Hydrophobia approaching.

3d of Auguſt. Sunday. Complained of pains ſhooting from, and along the right arm, to the ſhoulder, and from thence along the neck to the throat.

His ſleep diſturbed; when rouſed he ſighs, and was hurried and depreſſed, with a reluctance to ſwallow fluids.

4th of Auguſt. Monday. He was viſited by Mr. *Collet*, ſurgeon, in Bromſgrove, in the abſence of Mr. *Woodcock*, the ſurgeon and apothecary he uſually employed. Mr. *Collet* obſerving him turning from water, with uncommon horror, ſuſpected the nature of the diſeaſe.

5th of Auguſt. Tueſday. The averſion to liquids encreaſed: the misfortune of his having been bitten was recollected; and it was now firmly underſtood, that the dreadful diſeaſe Hydrophobia, was that with which he was affected.

The ſight, and the noiſe of a fluid, as well as the touch of it, and, its approach to the mouth, produce violent emotions, and ſighing, with ſpaſms extending to his hands, and every part of his body; with an inexpreſſible horror and agony. Yet he does not know his complaints proceed from the bite of the mad dog: and, to uſe his own words, " He cannot conceive what is come to him, that though he is very thirſty, the approach, look, and taſte of drink, ſhould, even in thought, ſo much afflict him."

He eats and ſwallows ſoft toaſted bread, potatoes, and roaſted aples, at the ſame time, tolerably well.

6th of Auguſt. Wedneſday. This day he began to take medicines well adapted to his caſe, by the direction of Mr. *Woodcock*.

7th of Auguſt. Thurſday. About ſix o'clock in the evening, when I viſited him, he had taken five doſes of the following bolus.

R. Extract. theb. gra. i.
Turpeth mineral. gra. iii.
Conſerv. roſar. q. s. f. bolus.

Beſides this, a powder of calomel and ſugar, to the quantity of a drachm, had been rubbed within his mouth; and an ounce and half of ung, cœrul. fort. had been rubbed upon his body.

Under this courſe, he had vomited ſeveral times in the night, and this morning. He alſo had ſeveral ſtools, and made water.

But the Hydrophobia was not abated, and I heard him wonder at his averſion to liquids; which I ſaw exemplified, in a manner that forbid the encouraging a repetition of the terrible ſtruggle the patient underwent.

His pulſe beat only ſixty-four ſtrokes in a minute, and frequently intermitted.

I ordered the mercurial plan to be continued and enforced, without intermiſſion: and being anxiouſly deſirous to haſten ſalivation, he was fumigated in my preſence, with cinnab. factit. and calomel; a drachm of the firſt, and half a drachm of the laſt, were, I believe, raiſed in fume before I left him: which he bore tolerably well, yet not without a certain degree of hurry, though the pulſe ceaſed to intermit.

I directed a vomit, of ſix grains of turbith mineral, to be given immediately, unleſs he before vomited.

The fumigation to be repeated every ſix hours; and half a ſcruple of calomel to be taken alſo every ſixth hour, in the intermediate ſpaces.

The following ointment was to be rubbed in thrice, in the twenty-four hours, till he began to ſalivate.

R. Camphor. drach. i. ſolve ol. ſuccin. q. s.
Ung. cærul. fort. ſemi unciam. f. unguentum.

A bliſter to be applied to the right wriſt, where he had been bitten: and milk and calves-feet broth were directed to be injected by glyſter, four or five times in twenty-four hours, with the addition of tinct. opii. gutt. xxiv. to each glyſter.

Theſe directions, however, were very imperfectly executed, as the patient was left to the care of an aſſiſtant, who had not that influence and authority, which is indiſpenſably neceſſary to overcome the reluctance patients in that miſerable ſtate have to efforts of every kind, even thoſe moſt neceſſary to their recovery. So that after my viſit, he had only one of the calomel powders, and one turbith bolus; two or three glyſters, which remained in the body; every thing beſides was laid aſide, except a repetition of the mercurial unction, twice or thrice more, ſo that the quantity rubbed in, amounted nearly to three ounces.

He continued reſtleſs this night, (Thurſday,) at times delirious, though with intervals of ſenſe. In general he had no ſleep.

8th of Auguſt. Friday forenoon. He took milk and whey in a ſpoon, and ſwallowed to the quantity of a pint: and continued taking milk or whey, in this manner, the remainder of the day, with tolerable eaſe, though it was neceſſary to preſs his noſtrils, in order to promote his ſwallowing: and in this point he ſeemed much relieved, till near the time of his death.

This day, all medicine was given up: Mr. *Woodcock* found him delirious in the ſucceding night, and raving to the greateſt degree; and in this ſtate he continued, till near the time he expired, which happened about one o'clock on Saturday morning, the ninth of Auguſt. Though he ſpit much about him, the evening preceding his death, yet no mercurial ſalivation had been raiſed by the mercurials he had applied to him.

This melancholy caſe ſuggeſts one or two obſervations.

1. It is remarkable, that ſo large a quantity of mercury, internally and externally applied, excited no ſalivation. Quere? Does the impreſſion of the poiſon on the nervous ſyſtem, render it inſenſible to the action of mercury, and, to a conſiderable degree, unimpreſſible by it?

2. Though this fatal caſe is not much in favour of mercurial remedies, neither is it abſolutely unfavourable.

favourable. The length of time the patient ſurvived from the firſt ſeizure of Hydrophobia, was at leaſt ſeven days: and his having been able to ſwallow fluids, in a conſiderable quantity, with leſs averſion than at firſt, may be imputed to the method of treatment, and principally to mercury; and it is to be lamented, that it was diſcontinued too ſoon.

3. In more than forty years attention to medical ſtudies, this is only the ſecond patient labouring under Hydrophobia, which has come under my immediate obſervation; and the firſt under my direction. The rareneſs of the diſeaſe, in one point of view a happy circumſtance, has probably been the occaſion of its remaining incurable.

By a combination of circumſtances, medicines were not very early applied in this caſe, or ſteadily continued: and the diſeaſe being both terrible and rare, the conſternation of the attendants moſt generally prevents ſuch a reſolute perſeverance, in remedies, as the nature of the calamity requires; and thus the patient is abandoned to his ſad fate: from ſuch circumſtances it happens that this diſeaſe, though it may be not in its nature incurable, is ſtill ranked among the opprobria medicorum.

Hence every addition to the certainty of prevention,

tion, ſhould be carefully followed. The method propoſed by my ingenious friend, Dr. *Haygarth*, of pouring warm water upon the bitten part for a very long time, is ſo eaſy in application, and ſo likely to be ſucceſsful, that it ſhould always lead the way in every prophylactic proceſs, and particularly in that I have recommended in the former eſſay.

4. I have frequently, in nervous and highly ſpaſmodic affections, obſerved a conſiderable difficulty and ſtruggle in ſwallowing either ſolids or liquids: but the ſpecific horror to liquids, as ſuch, was wanting. I have alſo met with patients, who, from terror, believed themſelves affected with Hydrophobia and canine madneſs. The ſymptoms have been ſuch as made practitioners often believe, the patients laboured under the genuine Hydrophobia; and the treatment which ſucceeded in curing ſuch maladies, has been held out as an effectual cure for that diſeaſe. This accounts for the credit medicines have in all times acquired, as remedies for the Hydrophobia; and for their failure, when tried in the genuine Hydrophobia.

Many phyſicians, of great experience in other diſeaſes, have lived and died without ſeeing one caſe of true canine Hydrophobia: that nervous diſeaſes ſhould, in ſome caſes, impoſe upon ſuch perſons, I can readily conceive: but whoever has ſeen *only one patient*, labouring under the true Hydrophobia, can never afterwards be miſtaken, or miſled, by any appearances reſembling it: with ſuch ſtrong, and inexpreſſibly pathetic ſignatures, is the horror to liquids, marked in patients, labouring under this dreadful malady!

5. The ſaliva of rabid animals, appears from the beſt evidence, to be the only vehicle of infection. And, there is no proof of its being communicated by milk, blood, ſeminal liquors, or ſweat. The milk and fleſh of mad animals, have been taken internally, without any bad conſequence.

It is matter of doubt, indeed, by what channels the infection is conveyed into the ſalivary glands, as no evidence evinces its having been abſorbed by the lymphatic veſſels only, as the variolous, and ſome other poiſons are.

It may be diffuſed in the maſs of circulating blood, in a ſtate fit to furniſh the matter for the poiſonous ſecretion, which takes place in the ſalivary glands of the tainted animal, though the blood only be incapable of giving the diſeaſe.

Thus the blood of perſons infected with the ſmall-pox, appears incapable of communicating the diſeaſe by inoculation, and yet the puſtules ſeparated from it, diſſeminate that diſeaſe.

Thus, too, bile, ſemen, common ſaliva, and other liquors ſecreted from the blood, are nevertheleſs totally different from it.

Quere. Does not the tainted ſaliva of rabid animals, mixing with the fluids, and affecting the nerves, give a peculiar morbid action to the ſalivary glands, fit for the aſſimilation, or, preparation of the poiſonous ſaliva?

However the poiſon is formed or conveyed, it is evident, from the taint the ſaliva ultimately acquires, that its action is not limited to the part injured; though one of the early marks of injury, may be pain in that part; as happened in the caſe I have laſt related.

Nevertheleſs, I agree with an ingenious obſerver,* that ablution and exciſion of the part, ought at no time tobe neglected, if omitted at firſt; and, that it may even be uſeful, when the patient is afflicted with the Hydrophobia.

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* Dr. *White*, St. Edmundſbury, in Medical Memoirs, third vol. p. 608. And, in ſuch unhappy circumſtances, when nothing probable ought to be omitted: particular regard ſhould be given to the caſe of a patient, affected with the ſymptoms of Hydryphobia, ſucceſsfully treated with ſweet oil, uſed internally and externally, by Dr. *Shadwell*. See Med. Mem. vol. ii. p. 454.

XIII.

Cynanche Pharyngea: or, Defect of DEGLUTITION, *from a ſtraitning of the* ŒSOPHAGUS.*

LORD BACON, in the work "De Augmentis Scientiarum," incites phyſicians to attempt to leſſen the number of fatal diſeaſes by new methods. Impediments to the paſſage of food into the ſtomach, from a ſtricture, a thickning, or ſcirrhus of the pharynx, or in ſome part of the œſophagus, is ſo frequent, and ſo very juſtly accounted a dangerous and fatal diſeaſe, that I hope any reaſonable endeavour to obviate its danger, will not be unacceptable.

Every one muſt have had experience, that this diſeaſe has reſiſted the moſt powerful remedies. *Van Swieten*, in his comment on § 797 of *Boerhaave*, gives a catalogue of medicines, applied in this caſe by himſelf, and other phyſicians, and all

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* See Art. xvii. Med. Mem. vol. ii.—Read June 4, 1787.

in vain. The tartarus tartariſatus, and regeneratus. *Starkey*'s celebrated penetrating ſoap, compoſed of oil of turpentine, and ſalt of tartar. Crude ſal ammoniac, and its volatile ſpirit, ſaturated with diſtilled vinegar, applied both outwardly and inwardly, with ſufficient perſeverance, either did no good, or only gave a ſhort and temporary reſpite, from a diſeaſe, which ſoon returned as bad as before.

Mercurial unctions, and mercurial plaſters, with the gums, applied to the neck, ſtrong purges, and even ſalivation itſelf, were unſucceſsful. Emollient decoctions, oily and lubricating medicines, were often ſerviceable, in rendering the paſſage more open, ſo long as any paſſage remained, but did not cure effectually and radically. The recent roots of the black hellebore, beat to the conſiſtence of a cataplaſm, with vinegar of ſquills, and bryony root, pounded with crude ſal ammoniac, and applied to the neck, failed. A probe, with ſponge, fixed on whalebone, and introduced into the œſophagus, to force open the ſtricture, was ineffectual, and manifeſtly hurtful, by irritating that ſenſible part, and encreaſing the pain and ſwelling in it.

I knew a murder committed, (I hope the faculty will pardon the expreſſion,) by an attempt to open a paſſage into the ſtomach, by this kind of forcible entry.

I have found lubricating oils, burnt ſponge, and mercurial unction, fail; I fear, when the œſophagus is much thickened, or, when a ſcirrhus blocks up the paſſage, medicine will be of little ſervice: yet, in this unhappy ſituation, a method may be adopted, which promiſes ſome good, and which entitles it to a preference to medicines of an irritating and ſtimulating nature. All the good that is to be done, will be effected by relaxing, or gently dilating the ſtricture. For this laſt purpoſe, bougies of a proper ſize might be tried, as propoſed, very judiciouſly, by Mr. *Wathen*, and endured without pain, or retching to vomit; and, eſpecially if followed with any advantage, they ought to be continued, and, from time to time, repeated; if otherwiſe, certainly laid aſide. The advantage is moſt likely to be ſecured, by giving boluſſes of butter, and other oily ſubſtances. I certainly have ſeen ſome palliative good done by oily linctuſſes. The food ought always to be milky, demulcent, nutrient, ſoft, and liquid. Though I have hardly ever ſeen mercurial unctions uſeful, I remember curing a perſon, by giving corroſive ſublimate, diſſolved in the ſpirituous tincture of Peruvian bark, in a manner ſimilar to the celebrated ſolution of *Van Swieten.* A ſpongy, relaxed appearance, in the uvula and glands of the throat, led me to adminiſter this medicine, which I, by no means, think likely to be generally uſeful.

Opium, and extractum cicutæ, bid fair, in my opinion, to be more generally uſeful in this diſeaſe, than any other medicines. They will operate powerfully in removing the ſpaſmodic ſtricture, which ſometimes is the ſole cauſe, and more or leſs attends every other cauſe of this diſeaſe. I remember a young woman, ſtill alive, who, without any inflammation, ſwelling, or apparent cauſe in the throat, for ſeveral days, laboured under this diſeaſe of the œſophagus, ſo that no ſolid or liquid food paſſed into the ſtomach. She was cured by taking fifteen drops of thebaic. tincture, on ſugar, every four hours. She took ſix doſes in this manner, before the ſtricture yielded to the medicine; but has remained well, and free from the diſorder, ever ſince the year 1780. I judged her diſeaſe proceeded from ſpaſm; but think it highly probable, that if it had not been removed by the medicines, a thickning of the œſophagus would ſoon have enſued, and the diſeaſe have become permanent and incurable.

In 1782, I was conſulted for —— *Robinſon*, a tenant of *W. Childe*, Eſq. of Kinlet, and who uſed to accompany him in the ſports of the chace. He had, for a conſiderable time, laboured under a diſeaſe, reputed incurable, which had prevented all food from paſſing into the ſtomach, from an obſtruction below the pharynx. I ordered a grain of extract. thebaic. with a few grains of extract of hemlock, to be taken in the form of pills, two or three times in the day, but to hold them in the mouth till diſſolved, and to ſwallow the ſolution with the ſaliva; and to avoid every attempt to take any thing elſe, which might bring on ſtraining, and force the medicine back again. By adhering to this method a few days, the obſtruction was removed, and the power of ſwallowing ſolid, as well as liquid food, was perfectly reſtored. The diſeaſe, however, returned, and was fatal to him, about three years afterwards. I imputed this to the habitual indulgence of drinking ſpirits and drams; and it is ſomewhat remarkable, that he, after this relapſe, neither uſed the method, nor the aſſiſtance of him who had adminiſtered relief, till it was viſibly too late to be uſeful.

I have applied the ſame method and medicines, ſince that time, in ſeveral inſtances; and from the ſucceſs, I venture to recommend the plan, in preference to any hitherto in general uſe, for this formidable malady.

When the preſſure of ſwelled glands is found to be the obſtruction to deglutition, which I remember to have happened in ſome caſes of bronchocele, and which may be ſuſpected, if the patient has knots in the glands of the neck, or any other marks of ſcrophula. In ſuch circumſtances, the deobſtruent medicines, which are ſpecifically proper in ſcrophulous diſeaſes, are indicated. In order to give ſuch medicines efficacy, it is neceſſary to apply them topically to the abſorbing orifices of the lymphatic veſſels, which enter into the obſtructed glands, and again emerge from them, in their courſe to the lacteal duct, where it diſembogues its contents into the ſubclavian vein. This is a point of great importance; for, being thus applied, medicines will, very probably, go in full power and efficacy into the obſtructed glands.

Medicines which are conveyed into the body by the lacteal veſſels, have no ſuch advantage. They mix with the blood, and, circulating with it, have only a remote chance of ever arriving at the ſeat of the obſtructions intended to be removed. In order to arrive at theſe glands, they muſt be thrown out in ſecretion, and again abſorbed by the lymphatic veſſels, which are to convey the lymph to the glands in queſtion, and, along with that lymph, theſe ſpecific medicines; a piece of luck, if duly conſidered, hardly to be expected.

It is therefore certain, that the holding the medicines directed for the bronchocele, under the tongue, till gradually diſſolved, is, in the higheſt degree, a rational practice, and, indeed, found ſuch by experience, long before this reaſon was thought of, as being neceſſary to their efficacy.

I preſcribed for a lady of a ſcrophulous habit, and who has had repeated returns of an obſtruction in the paſſage of food along the œſophagus, the following bolus:

℞. Spong. uſt. Flor. Martial. a ℈i.
Conſerv. Roſar. q. s. f. Pila ſublingualis.

which ſhe was ordered to hold under her tongue, till diſſolved, and to ſwallow the ſolution; this ſhe did for a fortnight or three weeks, at bed-time every night, and has been conſtantly cured by it.

I am certain the ſame mode of adminiſtration, will add greatly to the power and efficacy of any other medicine, which may be thought proper in ſuch circumſtances. But early application to medicine is, in this, as in all other dangerous diſeaſes, of the utmoſt conſequence to its ſucceſs.

AN

ESSAY

ON

MINERAL POISONS.

BY

JOHN JOHNSTONE, M. B.

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FELLOW OF THE MED. SOC. OF EDIN. AND LONDON;

AND LATE PHYSICIAN TO THE INFIRM. WORCESTER.

1795.

ADVERTISEMENT.

THE following Eſſay forms part of a collection on medical juriſprudence, which the Author hopes, ſome time or other, to lay before the public. In publiſhing it, he has ſubmitted to the, perhaps, too partial opinion of thoſe, whom he is equally bound by duty and inclination to reſpect; and who thought, that it would form a proper practical continuation and appendix, to ſome of the tracts contained in this volume. He is fully conſcious of the defects of his work, and how ſmall a claim it has to public attention; yet, he truſts, that he ſhall meet with ſome indulgence, when it is underſtood, that it was originally drawn up, not for the inſpection of medical men only, but for the uſe of a profeſſion whoſe education, though moſt liberal, cannot be expected to comprehend ſubjects, ſo remote from their more general purſuits. To adapt it to its preſent ſituation, and to render it more capable of general utility, a ſketch of the mode of action, and of the cure of each poiſon, has been added. It may appear inconſiſtent, to publiſh in the ſame volume, ſentiments ſo different on the ſame ſubjects, as will appear in the following Eſſay, from thoſe of ſome of the other tracts. But whenever he differs, though it is with deference and reſpect, yet it is without regret, being well aſſured, that many a ſpark of truth has been ſtruck, by the claſhings of opinion, and that the cauſe of ſcience, muſt eventually be advanced by all moderate and ſober diſcuſſion.

Birmingham, Dec. 1794.

AN

ESSAY

ON

MINERAL POISONS.

THOSE mineral ſubſtances, which, when taken internally, or applied externally to the bodies of animals, in certain ſmall quantities, prove univerſally hurtful or deſtructive to them, by a ſudden and ſpecifically deleterious operation, are called poiſons. I ſay, that in certain ſmall quantities they prove hurtful, by a ſpecifically deleterious operation, becauſe *all* the mineral ſubſtances are dangerous, when taken in exceſs. A ſmall quantity of chalk, or ſand, will paſs through the bodies of animals without danger: but the ſtomach may be ſo clogged, by a large quantity of theſe ſubſtances, as to endanger life, and even to deſtroy it. It would be abſurd however, to rank chalk, or ſand, among the poiſonous minerals, becauſe from their bulk they might produce theſe effects, ſince, in no caſe, can they be denominated ſpecific. A large quantity of flour; of the moſt ſimple and innocent article of food, may be crammed into the ſtomach in ſuch a manner, as to deſtroy its action, and therefore, with equal propriety, might be called poiſonous.—It would be equally abſurd to exclude from the liſt of poiſons, all thoſe ſubſtances which may be given to animals in very ſmall quantities, without injury. Conſidering the ſubject in this view, the word poiſon ſhould be expunged from language, as probably even animal poiſons will not produce their contagions, unleſs in certain quantity; and we are acquainted with no powers that act in ſmaller quantities than theſe. The portion of variolous matter, diffuſed through the hundredth part of a grain of pus, will produce the contagion of the ſmall-pox.

The idea attached to the word poiſon, in Engliſh, is clear and appropriate, and correſponds to the action I have now defined: it is ſo too in French, Spaniſh, Italian and German, and, as far as I know, in all other languages of Europe. In Latin and Greek,* the meaning is double: PHARMACON

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* R. Stephani Theſaurus in Veneu. Aulus Gellius. Lib. xii. chap. ix.

MACON ſignifies a remedy, as well as a poiſon; and *venenum* is not always to be underſtood as a poiſon.

The mineral poiſons may be divided into two claſſes; thoſe whoſe operation is ſo ſudden and obſcure, as almoſt to baffle conjecture; and, thoſe whoſe operation we can partly explain, as proceeding from their acrid or corroſive qualities. Suddenneſs of effect, is a neceſſary quality of a poiſon. Lead, ſwallowed or abſorbed, in ſmall portions, ſeems, at firſt ſight, to afford an exception. But when we conſider, that theſe ſmall portions are accumulated in the body, and that the operation does not commence, till a ſufficient quantity to produce action is accumulated, the objection vaniſhes. A certain quantity of arſenic may be ſwallowed, without any apparent injury: ſo may a certain quantity of lead. But each of theſe poiſons will produce its appropriate effects, if repeated; nor can either the one or other, be denominated a ſlow poiſon, becauſe, when adminiſtered in ſmall quantities, and at intervals, a longer time elapſes before they produced them. The preſent ſtate of our knowledge, does not furniſh us with any poiſon, and perhaps none ſuch exiſt, as that which, from a ſingle doſe, produces no immediate effect, but takes the time of weeks, or months, ſlowly to conſume the vital principle. The effects of a doſe of poiſon, may be ſo far overcome by ſtrength of conſtitution, or the judicious adminiſtration of remedies, as not to prove *immediately* fatal; yet the patient may linger many months, and, at laſt, ſink under the debility occaſioned by its operation: but, as this is not its uſual operation, it ſhould be conſidered no more as a ſlow poiſon, than a wound, which nine hundred and ninety-nine times out of a thouſand proves fatal, is not to be conſidered of a genus of wounds that are mortal, if by chance it ſhould be healed.—In all reaſonings and judgments upon any caſe, our argumeuts ſhould be guided by general, and not particular, events.

Before I enter on the enumeration of the ſeveral mineral poiſons, and their effects, I muſt beg leave to anticipate ſome remarks.

"On few of the poiſons he enumerates, has the author made any experiments himſelf. In ſupport of many of his reaſonings, he has adduced analogies, inſtead of actual facts: and, in many of them, he is not ſupported by a ſufficient weight of the authority of others."

To the firſt objection, I muſt plead guilty; nor have I any other apology to make for the neglect, than a ſpecies of weakneſs, which incapacitates me from making thoſe experiments on animals, which expoſe them to great and continued torture. Some attempts I have made, of this kind; and I muſt own, with ſhame, that the conſequences have determined me, never to repeat them. Experiments with vegetable poiſons, by which, probably, ſenſation is immediately deſtroyed, or on thoſe ſubjects in which the ſource of ſenſation is cut off, may always be made, without pity or remorſe: as it can be of little conſequence, whether we deſtroy the lives of animals for food or for information, provided they are deſtroyed with the leaſt poſſible degree of pain. From the facility with which this kind of experiments may be made, there cannot be wanted opportunities of gaining every neceſſary information on the ſubjects in queſtion; nor is that information, particularly with reſpect to mineral poiſons, of ſuch conſequence, as to induce any one to make a conſiderable ſacrifice to obtain it, No one will ſurely riſque much, where much cannot be gained.

It will not be neceſſary for me to inſiſt on the uſe I have made of analogy. Every one who thinks, muſt obſerve, that the greater part of our knowledge of poiſons, muſt be derived from this ſource. Few are the inſtances, in which we have an opportunity of obſerving their effects on the human body; and can any one wiſh them to be more numerous? The practices of *Herophilus* and *Eraſiſtratus*,* can never again be tolerated, whilſt

humanity

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* Qui nocentes homines vivos inciderint. Celſus in Præfat.

humanity and reaſon retain their empire over mankind. I muſt confeſs, that in ſome few caſes, I am not ſatisfied with the only authorities that I have been able to adduce: yet I have turned over every author in my power, who was likely to afford illuſtrations, and have availed myſelf of their aſſiſtance. For other parts of my work, the materials I found were ample: theſe I have gladly uſed, and with them, I truſt, the reader will not be diſſatisfied. In general, however, the authorities are far more ſcanty, than might be expected. I cannot give a better inſtance, than in referring to *Mead*'s elegant treatiſe on poiſons.

The Mineral Poiſons are either metallic; earthy; or ſaline; or compounds of one or other of theſe

I. The Metallic Poiſons are:

ARSENIC,	COPPER,
MERCURY,	LEAD,
ANTIMONY,	SILVER, and GOLD.

II. The Earthy Poiſons are:

CALCARIOUS EARTH, BARYTES, or ponderous Earth, and SILICIOUS EARTH.

III. The Saline Poiſons are:

The SULPHURIC, and the MINERAL,
NITRIC, ALKALI,
MURIATIC ACIDS,

I. The compounds of theſe poiſons are, in general, more virulent than the ſimple ſubſtances; and ſome of them become poiſonous *only* by combination.

1. ARSENIC, is ſoluble in water, and in all the acids and alkalies. It is often found naturally combined with many of the metals; and, by art, it may be combined with all of them. The baſe of arſenic conſiſts in an acid, which is procured by chemical analyſis. It is this acid that unites ſo readily with alkalies, and which may alſo be joined to ſulphur, metals, and earths. With ſulphur, the compound becomes, to a certain degree, innocent. All the other compounds are poiſonous, in proportion to the quantity of arſenic they contain. As it is not my buſineſs to dwell on the different preparations of arſenic, I beg leave to refer the reader, for a more particular account, to the ſecond volume of *Burgman*'s Eſſays, which contains a great number of good facts; although the theory by which they are explained, be now exploded.

It is before remarked, that all the compounds of arſenic are noxious, in proportion to the quantity they contain of the mineral: thus they are all milder than the pure acid. The regulus is leſs active than the white oxyd; and, perhaps, the neutral ſalts of arſenic, with alkali, are more mild than any of its other ſaline preparations, when there is no ſuperabundance of acid. I do not, however, inſinuate, that *any* of its preparations are void of danger. Sulphur ſoftens the acrimony of all the noxious metals; and yet they are not always to be truſted to, even when combined with it. The action of the ſtomach upon all the compounds that have one deleterious ingredient, may be ſuch, as to let it looſe in all its native malignity: none of them are ever to be implicitly truſted, ſince accident may uncombine them.

2. MERCURY, in its native ſtate, is entirely harmleſs; it becomes active only by combination with oxygene, or ſaline ſubſtances. With the three mineral acids, it forms the moſt active preparations. With the muriatic acid, it ſublimes into a poiſon as malignant and deleterious as the oxyds of arſenic, commonly called corroſive ſublimate. With the nitric acid, it forms another corroſive poiſon, leſs virulent, indeed, than corroſive ſublimate, but equally capable of deſtroying animal life, when adminiſtered in ſufficient quantity. Its compound

with the ſulphuric acid, is neither ſo corroſive, nor ſo fatal, in its uſual operation, as the former two; ſtill, however, its activity is ſuch, as to be capable of producing very dangerous conſequences. There are other preparations of mercury, reſulting from combinations with different quantities of acid, or alkali, &c. which, though leſs active than either of thoſe I have now enumerated, are far from being void of ſuch a degree of ſtimulating power, as to render them innocent. The oxyds of mercury, are active in doſes of three or four grains; they may prove, therefore, very dangerous ſtimulants, in the quantity of a drachm, or even of a ſcruple.—Sulphur renders mercury, as it does moſt of the other metals, to a certain degree, inactive. Compounds of this ſort, are often given in large quantities, without bad effects.

3. ANTIMONY, is uſually found united with ſulphur, and in this ſtate is inert. The pure oxyds ſhew but little activity, unleſs they meet with acid in the ſtomach, and then they are violently ſtimulating, in the ſmalleſt doſe. With acids, antimony ſhews all its power, and its preparations yield, in violence, in no reſpect, to thoſe of mercury. With the muriatic acid, it forms a corroſive compound, commonly called, butter of antimony; which can be compared with the muriated mercury, for violence. Its oxyds are active in much ſmaller quantity than thoſe of mercury.

4. Copper, is one of the minerals the moſt univerſally poiſonous we are acquainted with. In all ſtates, it is noxious to the bodies of animals; nor do I know of any combination that neutraliſes its baneful qualities. Water, the animal fluids, the acids, alkalies, and oils, all bring it into action. The liſt of its poiſonous preparations is not circumſcribed by any exception, unleſs ſulphur affords any; as copper, in every form, is deleterious to animals, in proportion to the quantity taken into their bodies.

5. Lead, in its metallic ſtate, is not ſo readily acted upon by the aqueous liquors, as copper; it is therefore not ſo dangerous, when ſwallowed in this form; and in no ſtate is its action ſo quick, as that of copper. Its combinations, however, are as various; and, in other reſpects, there are as few exceptions to its malignity.—With acids, lead forms its moſt active preparations.

Silver and Gold.

6. Silver, affords only two poiſons. The firſt is, when joined with the nitrous acid; the other, an oxyd of this metal, precipitated by means of ammoniac, called fulminating ſilver.* The firſt

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* Journal de Phyſique, 1788.—p. 474.

is one of the moſt corroſive ſubſtances we are acquainted with: the other, I never knew taken into the body, and conſequently cannot judge of its effects but by analogy. It is, probably, one of the moſt inflammable ſubſtances in nature, as it inflames at a degree of heat little above that of the human body, with a moſt tremendous exploſion.

Of fulminating GOLD we have ſome clearer knowledge. "In duobus Ægrotis (ſays *Plenck**) a tribus granis auri fulminantis tormina, ingentem debilitatem & profuſiſſimam vidi ſalivationem." He quotes inſtances when death was even produced by it. *Rolfincius* gave it to the quantity of ſix grains, and it only operated "Commota alvo:" and *Bergman*† quotes other authorities for its diaphoretic powers; but does not hint at any extremely violent internal operation. There are many ſhades between tormina, and, commota alvo, eſpecially when we conſider, that the greater effect was produced by the ſmaller doſe.

BISMUTH and ZINC, are ranked among the poiſonous minerals by ſome authors; in my opinion, without ſufficient authority. Biſmuth is, and has been long, ſo largly employed as a coſmetic, and a paint, a paint, that it is hardly probable, but its peculiar qualities would have been detected, was it peculiarly hurtful.* We muſt not argue from the ſimilarity of its general properties to lead, as it is well known, that many chryſtals and foſſils have all the marks of external ſimilarity, without the leaſt reſemblance in action.

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* De Venenis.—p. 241.—Note.

† Phyſical and Chemical Eſſays.—Vol. ii. p. 140.

ZINC, has a much better claim to the title of poiſon, on account of the activity of vitriolated zinc, which acts as an emetic, in the quantity of fifteen or twenty grains. It is moſt probable, that active compounds are formed by its union with the other mineral acids: but this I do not know from my own experience, nor can I aſſert from that of others. The action of vitriolated zinc is ſuch, that I think it will ſeldom ſtay long enough in the body, to produce any hurtful effects, in whatever doſe it be taken. The pure oxyd, can be given to the quantity of ten or twenty grains, often without any apparent effect; and when it does operate, only with ſickneſs. At any rate, none of the preparations † have a ſpecifically deleterious operation; and have, therefore, no better claim to be ranked among the mineral poiſons, than ipecacuan has among the vegetable.

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* *Nihcolſon*'s Elements of Chemiſtry, p. 342. — *Hoffman* de inſec. Med. tom. vi. p. 315.

† *M. de la Planche* ſwallowed ſalts, formed by zinc with vegetable acids, in much ſtronger doſes than could be contained in any aliments, prepared in copper veſſels plated with tin, without ſuffering from them any bad effects. — *Fourcroy*'s Elements of Chemiſtry, &c. vol. ii. p. 299.

Some of the other ſemi-metals, have been found occaſionally poiſonous; but as this happened from an admixture of arſenic, there is no reaſon for admitting them here.

So little is known of the compounds of Platina, that I cannot ſay, whether they are ever deleterious or not.

II. With the Earths, the poiſonous combinations, luckily for mankind, are few.

1. In its pure ſtate, Calcarious Earth is ſo cauſtic, that it muſt prove deleterious when taken internally, or applied even externally, in large quantities: in this form it is called quick-lime. When combined with carbonic gas, which it is always found to be in a ſtate of nature, it is entirely harmleſs. Combined with a pure, or, as it is called cauſtic alkali, quick-lime becomes much more corroſive, than even in its pureſt ſtate. All the other combinations are quite innocent.

2. Barytes, is always found united to a conſiderable quantity of carbonic gas; and I much

doubt, whether it be harmleſs, even in that ſtate: when the gas is expelled, it becomes, in moſt reſpects, like quick-lime, with all its corroſive qualities. With the muriatic acid, it forms a compound, which, by experiments on dogs, has been found deleterious.

3. Silicious Earth, cannot be ſaid to be poiſonous, in its natural ſtate; though, when mixed with alkali, and fuſed into glaſs, it affords a ſubſtance, which, by its mechanical action, is capable of doing the greateſt injury to the ſtomach, and thereby of deſtroying life. In the ſame way, the natural compounds of ſilicious chryſtals, muſt be ſuppoſed to act. It may, perhaps, be too curious, to add theſe to a liſt of poiſons; as, with equal reaſon, ſmall pieces of ſharpened iron, might be ranked among theſe deleterious powers. I have purpoſely omitted many others; ſuch as Selenite, Calcarious Chrystals, &c.

III. All the concentrated Mineral Acids, are highly corroſive; therefore, when ſwallowed undiluted, they are noxious to animals.

1. The Sulphuric Acid, is moſt common; but none of its compounds, except thoſe with oxygene, are more corroſive than itſelf alone. Its acrimony is not corrected by admixture with the other acids,

as it is, to a great degree, by combination with alkalies. This acid is rendered more or leſs cauſtic, by the greater or leſs proportion of oxygene joined to it. — This is indeed the caſe with all the mineral acids

2. The Nitric Acid, is more corroſive in its moſt oxygenated ſtate, than the ſulphuric, and is more active than any of its own preparations. With the muriatic acid, it forms a very cauſtic compound, called aqua regia, on account of its power of diſſolving gold. With the alkalies, its neutral ſalts are far from being inert, though they are infinitely leſs active than the concentrated acid.

3. The Muriatic Acid, in the ſtate we commonly meet with it, is very corroſive; but its powers are wonderfully encreaſed by the addition of oxygene, in double quantity: it is then, probably, one of the moſt powerful ſolvents in nature. Combined with mineral alkali, it forms common ſalt, which certainly cannot be denominated poiſonous; and with other alkalies, its compounds are far from being remarkably active.

4. Of the Alkalies, that which is called Soda, or Natron, is the only one that is indiſputably mineral, and even this is prepared in great quantities, from plants. But it exiſts in ſuch pro-

digious abundance in the waters of the ocean, and in an uncombined ſtate, in ſome particular parts of the earth, that its origin is rendered certain. The mineral alkali, collected from ſea ſalts, or by any of the uſual modes of collecting it, is always found united to a very large proportion of carbonic gas. In this ſtate, it is ſufficiently active to prove hurtful to animal bodies, when taken in large quantity: but its powers are not fully unfolded, till all the gas is expelled; it then becomes ſo corroſive, that it has obtained the name of cauſtic alkali. When united with acids, it is converted into ſalts, mild in proportion to the acridity of the ingredients, though in moſt caſes, retaining a certain degree of activity.——When mixed with pure calcarious earth, or barytes, the compounds are more cauſtic than either of the original ingredients.

What is ſaid of the Mineral Alkali, will apply to the VEGETABLE and VOLATILE, for the moſt part; reckoning a greater degree of activity in both of theſe.

I have thus haſtily ſketched an outline of all the Minerals, and their compounds,* which are poiſonous,

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* I ſay all, becauſe I know no more. Whether others may be generated in the progreſſion of things, can only now be a ſpeculation. *Buffon* thinks, that animal ſubſtances may be converted into poiſons, by long maceration and decompoſition. He obſerved little darting ſpi-

cula,

ſonous, when taken internally, or applied to the bodies of animals. I ſhall now proceed to determine their effects; and ſhall reſt, with encreaſed attention, upon the poiſons, whoſe virulence has long excited the terrors of mankind, from the ſmallneſs of the quantity in which they prove fatal. Thoſe whoſe corroſive qualities are evident to the touch, and that act in a mechanical way, will require leſs inveſtigation.

I.

METALLIC POISONS.

1. ARSENIC,[*] in all forms, that with ſulphur alone excepted, is a ſure poiſon in doſes of ſix or eight grains, when taken internally; and, in ſome caſes, it proves fatal in the ſmall quantity

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cula, which, from their reſemblance to the poiſon of the viper, obſerved by *Mead*, he thought might be poiſonous. People now will probably account for this appearance, by the chryſtalliſation of the lithic, or ſome other acid.—Hiſtory Nat. Tom. iv. p. 145.

[*] *Pliny* mentions arſenicum ſlightly, as a corroſive.—Nat. Hiſt. 34. 18.

Arſenicum,

quantity of two,* three, or four grains. It is corroſive to the taſte, and the ſenſation remains upon the tongue for a long time. If the white oxyd be taſted, the taſte is firſt of all acid, and ſubdulcid; which afterwards becomes penetrating and corroſive. When ſwallowed, this penetrating and corroſive taſte, extends all down the throat, and is ſoon followed by great heat, and contraction of the œſophagus, irritations, and nauſea. Slight and aching pains then ſucceed, which gradually encreaſe to enormous anguiſh. Inceſſant vomitings alſo come on; the pulſe becomes quick; the tongue and throat parched with heat, and intolerable

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Arſenicum, ſandaracha, auripigmentum, are mentioned by *Celſus*, as "quæ rodant, quæ purgent, quæ exedant."—Lib. v. c. 5, 6, 7, 8. But, in general, the ancients are not to be quoted as authorities concerning the action of poiſons; and perhaps they were unacquainted with the more virulent preparations of arſenic. Their opinions of their nature and operation, were as abſurd as their fears of them. Among the reaſons for thinking that *Germanicus* was poiſoned, *Suetonius* ſays, "Nam præter livores qui toto corpore erant, & ſpumas quæ per os fluebant, cremati quoque cor inter oſſa incorruptum repertum eſt, *cujus ea natura exiſtimatur ut tinctum veneno, igne confici nequeat.*"—Lib. iv.

The long liſts of antidotes, *Mithridate* and *Theriac*, that we derive from the ancients, are a potent proof of their terrors, and their ignorance.

* A lady put ſome arſenic into her mouth, to taſte what it was. When ſhe diſcovered that ſhe had been taſting poiſon, ſhe would uſe no preventive, believing that ſhe had ſwallowed none of it. Twelve hours afterwards, ſhe was ſeized with vertigo, and her body was univerſally convulſed. She continued in this ſtate a day and night; an eruption at the ſame time breaking out, like meaſles. She partly recovered in five days, but was an invalid for many years.—Edin. Med. Eſſays. iv. 41.

lerable thirſt. Exceſſive anxiety is felt in the cheſt; and reſpiration is performed with difficulty and diſtreſs. The limbs are affected with tremors and cramps; and the body, fluſhed and ſpotted, at laſt ſwells to an immenſe ſize; when ſuddenly the pains abate, and the by-ſtanders flatter the patient's recovery of health. But all the other ſymptoms continue unabated: the pulſe is quicker than ever, the intolerable ſenſe of heat and thirſt is rather aggravated, delirium comes on, with hiccup, cold ſweats, and convulſions, the countenance contracts a leaden hue, and death puts an end, at once, to torment and to hope.

This is the general courſe of the ſymptoms; but they are often varied in particular caſes. Sometimes the delirium and convulſions accede early, and during the more violent action of the poiſon, but more commonly towards the cloſe. The vomiting is generally tinged with blood; and ſometimes the diſcharges by urine and ſtool, are alſo bloody: but theſe effects take place leſs frequently when the action of the poiſon is quick, than when it is protracted.*

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* For an account of the ſymptoms, &c. ſee Mangeti Bibl. Med. Pract. Tom. iv. p. 821.

Lieutaud Hiſt. Anatom. Med.—Vol i. p. 39. obſ. 154.

Wepfer Cicut. Aq. Hiſt.—C. xxi. 3.

Morgagni de ſed. & cauſis Morb. lix. 3, 6.

On diſſection, the mouth, œſophagus, and ſtomach, are always found inflamed: the ſtomach particularly about its orifices; and its coats are ſo much intenerated, that a finger can be paſſed through them with a ſlight degree of preſſure: 'tis alſo frequently corroded; and the corroſions are ſo peculiar, that they may be diſtinguiſhed, with care and attention, from thoſe of the digeſtion of the ſtomach, by the gaſtric liquor. From the gaſtric juice, the corroſions are jagged and irregular, and are only obſervable in the depending parts of the ſtomach. From arſenic, they are regular, as if nicely punctured by an inſtrument, and are obſervable in all parts of the ſtomach which the poiſon has touched, ſurrounded by the appearances of inflammation.

The duodenum, and ſmall inteſtines, generally partake, in ſome degree, of the inflammation, and ſubſequent mortification. Wherever the poiſon touches, there will be inflammation, and an uncommon ſecretion of mucus; and it may be carried through the whole extent of the inteſtines. Little information can be gained by examining other parts, than thoſe immediately affected by the poiſon: with this view, the ſtomach and inteſtines ſhould be minutely examined. We ſhould not reſt contented with merely inſpecting the ſtomach; particles of poiſon may be puſhed forward, as far as the rectum, and produce their effects through the whole extent of the alimentary canal.

The brain never ſhews any particular mark, by which we may judge, whether a poiſon has been taken. The lungs are ſometimes interſperſed with black ſpots, and the right auricle of the heart is generally full of black blood. Theſe appearances, probably, ariſe from the difficulty of reſpiration, or from its ſudden interruption, and, are no criterions of poiſon; they are commonly obſerved in all caſes of ſudden death.* The ſcrotum, and genital parts of men, are ſaid to grow very ſoon putrid after death, from the poiſon of arſenic. Whether this is always ſpecially the caſe, I do not know: certain it is, that the whole body much ſooner aſſumes this appearance, than after any other cauſe of death, that is not equally ſudden.

On examination of the contents of the ſtomach, if arſenic were taken in its pulveriſed ſtate, grit will be perceptible by the fingers; and in the ſmalleſt quantity, it will conſtantly ſink in water.

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* Black ſpots in the lungs, are always remarked as following death in all caſes of poiſon. I do not believe that they are any thing more than coagulations, from the ſudden ſtoppage of circulation, and that they generally will be obſervable, when death occurs ſuddenly, in full health. —— *Wepfer* mentions them, as appearing in the lungs of a woman, who was opened while yet warm, after being beheaded.—Cicut. Aq. Hiſt. cix. p. 150. And I have ſeen them twice in healthy men, the day after they were hanged.

At any rate, it will emit fumes of a garlic odour, if ſprinkled on a red-hot piece of iron, with ſome powdered charcoal, or any other inflammable ſubſtance; and theſe fumes will leave white ſpots on poliſhed copper.* The ſmalleſt portions of arſenic produce theſe effects, There are other modes of diſcovering it, by chemical teſts and analyſis,† but I do not know whether they are more to be depended upon, than theſe I have adduced: they are certainly neither ſo eaſy, nor ſo fit for general uſe.

But it is not only when taken into the ſtomach, that arſenic produces its fatal conſequences. Worn in amulets, as it was formerly thought a ſpecific againſt the plague, there are many inſtances of its having occaſioned dreadful diſeaſes, and even death:‡ and uſed externally, in lotions‖ or ointments,

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* The beſt way of trying whether a ſuſpected ſubſtance be arſenic, is to place it upon two poliſhed pieces of copper, worn halfpence for inſtance, and heat them red hot. White corroſions will be obſervable, if the ſubſtance actually was arſenic.

† Arſenic, diſſolved in vegetable alkali, added to a ſolution of vitriolated copper in water, turns it to a beautiful light green. White arſenic added to pure water, impregnated with the air, let looſe by pouring ſulphuric acid upon alkaliſed ſulphur, immediately is converted into orpiment, and becomes yellow,

‡ *Mead* on Poiſons.—P. 220, 221. 8vo.

‖ Militis ſcabioſi decocto arſenici, ſeſe abluentis, genitalium ſphacele, cum ments, and applied in fumes,* it is probably as deleterious, as when ſwallowed, if it be applied in ſufficient quantity. In theſe caſes, it is not eaſy to detect the cauſe of death, ſince the arſenic taken into the circulation by abſorption, either ſuffers ſome chemical change, or is ſo minutely divided, as to be imperceptible by any teſt yet diſcovered. Nor are the ſymptoms ſo appropriate, as to warrant any poſitive deciſion concerning their cauſe. Sickneſs, convulſions, and vertigo, are ſymptoms of diſeaſes that do not ſpring from poiſons: nevertheleſs it muſt be acknowledged, that their catenation in caſes of poiſon, is very ſingular; and that the accurate obſerver, may form a judgment that will be more than probable, although not founded in abſolute certainty.

The ſymptoms produced by the external application of arſenic, are very different from thoſe which follow its reception into the ſtomach. In the firſt caſe, great giddineſs, with heat, thirſt,

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cum intolerabilibus doloribus, febre, vigiliis, ſiti obortis, peſſime luere.

Arſenicalis pulvis cancro mammæ adhibitus, mulierem intra quinq dies crudeliſſime rapuit. — *Crantz*, Mat. Med. T. iii. p. 25.

* Dum arſenicum repetitis ſublimationibus fixare tentabat Tachenius apertis vaſis, inſpiravit auram ſuaviſſimam, ſed poſt *ſemihorulam* imprudentiæ ſuæ pænas luebat. Dum & difficulter ſpirabat, omnium membrorum convulſiones patiebatur, ſanguinem mingebat cum intolerabili ardore, &c. — *Van Swieten*, Com. ii. p. 715.

quick pulſe, difficulty of breathing, and anxiety, generally precede any local inflammatory ſymptoms: in the latter, the moſt violent ſymptoms of inflammation are produced, almoſt as ſoon as the poiſon can act on the ſtomach; and the apparent operation continues local, till near the cloſe. From internal application, *all* the powers of life are attacked at once; the anxiety is extreme, as ſoon as there is any ſickneſs or pain in the ſtomach: nor is the ſtomach always one of the firſt parts affected. Though for the moſt part, the ſtomach and bowels are firſt affected with violent pains, which wander to different parts of the body; an ardent fever rages, with exceſſive thirſt; the ſecretory organs are excited into ſtronger action; great heat is felt with all the diſcharges, which are often bloody, as well as encreaſed in quantity; when convulſions and delirium cloſe the ſcene.

In both caſes, thoſe who eſcape from immediate danger, enjoy but a feeble degree of health ever after. They are generally tormented by veſicular eruptions, very difficult to heal, and are frequently attacked by palſy, or by hectic fever.

The effects of arſenic are eaſily diſcriminated from thoſe of all the other mineral poiſons, except corroſive ſublimate. From this poiſon, the diverſity of ſymptoms is not very great: this diverſity, however, it is of conſequence to mark. When either of theſe poiſons are found in the ſtomach or inteſtines, the inquiry need not proceed farther. The criterion of arſenic, before given, will be ſufficient to diſcriminate it from corroſive ſublimate, and, indeed, from every other poiſon.—No mineral has the ſmell of garlic, when expoſed to heat, unleſs it contains arſenic. The ſymptoms produced by arſenic, neither accede ſo quickly, nor do they diſcover ſo active a corroſive cauſe, as thoſe of ſublimate: the vomiting and purging are ſeldom ſo bloody, conſtant, and ſevere. Arſenic ſeldom excites ſalivation; whereas corroſive ſublimate moſt frequently has this effect, at the ſame time that the jaws, gums, and throat, are ſwelled to a great degree. When the effects are chronical, palſy is a frequent ſymptom of both theſe poiſons; but from corroſive ſublimate, it is always a general affection, whereas from arſenic, it has been ſometimes obſerved to fix more particularly in the fingers and hands.* It muſt be obſerved, that the marks of diſcrimination are not very ſtriking, indeed ſo little, as not to be depended upon, ſolely, in any caſe. When combined with other cicumſtances, they may be remembered ſometimes with utility, particularly when the patient lingered ſo long, as to have no chance of finding the remains of the poiſon, that cauſed his calamity.

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* *Falconer*, in Mem. Med, Soc. London.—Vol. ii. p. 224.

The time in which arſenic kills, is varied by numerous circumſtances. Age, conſtitution, habits, and the quantity of the poiſon taken, all create a diverſity, which it is impoſſible exactly to eſtimate. If the quantity ſwallowed be large, the fluid contained in the ſtomach, at the time of ſwallowing it, ſmall, and the body in good health, it may deſtroy in three or four hours: if, on the contrary, it were ſwallowed with a large quantity of fluid, by a perſon of infirm health, the fluid would act as a ſheath to the ſtomach, and the weakneſs of the body, would render the vital principle leſs capable of deſtruction, from the violent action to which it was expoſed, and, conſequently, life might laſt thirty or forty hours. I have known a healthy adult, die in three hours and a half, after taking an enormous doſe of white arſenic; and have been informed, by perſons of experience, that it has killed in two hours.[*] *Wepfer* mentions the caſe of a boy, who died in the fourth hour.[†] In general, from the vomiting excited by the acrimony of the poiſon, and from the exceſſive heat and inſatiable thirſt, which compel the patient to drink copiouſly, death does not take place till after eight, ten, or even twenty or thirty hours, and ſometimes two or three days.

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[*] *Mary Phillips* died in two hours after ſwallowing half an ounce of white arſenic, diſſolved in water.—A caſe recorded in many newſpapers.

[†] Cicut. Aq. Hiſt.—C. xxi. ſect. 7. p. 356.

From two or three hours and a half, therefore, till the periods before mentioned, may death take place, from what is called the immediate operation of the poiſon of arſenic.

In all caſes of recovery from immediate danger, the health is very infirm, and frequently ſinks, at laſt, under the effects of the poiſon. When the quantity of arſenic, either ſwallowed or abſorbed, is not ſufficient to deſtroy life by its immediate operation, it oftentimes excites a dangerous chronical diſeaſe, that is ultimately fatal: this has been the caſe too frequently from it, injudiciouſly adminiſtered as a remedy. Theſe diſorders frequently aſſume the appearance of palſy, ſometimes of phthiſis pulmonalis, and ſometimes of univerſal eruptions, with general debility, and vague, but violent pains.

Arſenic ſoon ſhews its virulence, when taken into the body. The heat of the throat immediately follows the ſwallowing of the poiſon; and the violent ſymptoms are ſeldom more than half an hour before they diſcover themſelves. *Tachenius*, in the inſtance cited, felt the effects of the fumes, in leſs than *half an hour*.*

From external application, the operation is not ſo ſpeedy. Mr. *Sherwin* felt effects from a very ſmall quantity rubbed into his hands, during the courſe of a night.* Had the quantity been larger, the operation probably would have been greater. At all events, a few hours will be ſufficient to diſcover the malignity of this poiſon, when externally applied,

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* Semihorula.

Arſenic has been taken, in the quantity of a grain, without any laſting bad effect. Mr. *Sherwin* ſwallowed half a grain, diſſolved in half an ounce of water, without remarking any effect. But to theſe doſes of the white oxyd, ſmall as they appear, objection muſt be made. No one can aſſert, that even theſe ſmall quantities may be univerſally adminiſtered without danger, eſpecially if repeated.

Of the degrees of virulence of the different preparations of arſenic, our knowledge is far from complete. Of the ſulphurated arſenics, orpiment is the moſt thoroughly ſaturated, and has been given to the quantity of a drachm, without injury: † but when not entirely neutraliſed by ſulphur, it has ſometimes proved fatal. The red arſenic, or realgar, is compoſed of about two parts of ſulphur, and nine of arſenic, and forms a poiſon little leſs virulent than the regulus of arſenic, or arſenic reduced to its metallic form. The acid of arſenic, uncombined, is probably more virulent than any of its combinations: the white oxyd is next to it. With acids, arſenic loſes little of its malignity; but with any of them it is combined with difficulty. With alkalies, it becomes to a certain degree, milder, but not to ſuch a degree as to warrant its more liberal uſe in this form. *None* of the preparations before mentioned, can be taken in larger quantity than a grain or two, without danger, orpiment only excepted; and ſome fatal accidents which have followed the taking of this preparation, in a few grains, render it a proper object of vigilance and ſuſpicion.*

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* Mem. Med. Soc. London. —Vol. ii. p. 397.

† *Plenck* de Veneris. —P. 276.

Hoffman Pathol. General. — Par. ii. c. 2. ſect. 13.

The following ſcale is not offered as exact. It will give a comparative view of the ſuppoſed virulence of the different preparations of arſenic, reckoning the moſt extreme degree ten. As arſenic is ſoluble in about eighty times its own bulk of water, any of the following preparations may be ſo given.

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* For ſome evil effects of orpiment, as well as the eaſy mode of uncombining it, ſee *Boyle*'s Works, by *Shaw*. — Vol. iii. p. 537, &c. —— Common ſalt, he ſays, makes it deleterious.

1. Pure arſenic acid —— 10
2. White oxyd of arſenic —— 9.
3. Acids, with arſenic —— 9.
4. Alkaliſed arſenic —— 8.
5. Regulus of arſenic —— 7.
6. Red ſulphurated arſenic, or realgar —— 6.
7. Yellow ditto, or orpiment —— 1.

There is no attempt here to diſcriminate the different degrees of activity of the acids, though ſuch difference undoubtedly exiſts. And the virulence of the different compounds is eſtimated upon the ſuppoſition, that the quantity of pure acid joined with them, is equal throughout. The quantities of each muſt be ſuppoſed different; for if there are ten grains of pure acid in all, there will, of courſe, be a ſurplus in quantity in each, in proportion to its acid, alkali, ſulphur, &c. Six is to be underſtood as a degree of great activity, and fatal in the quantity of a few grains.

Of the mode in which arſenic operates, there are two theories. The one is, that its deleterious properties are owing to the action of its ſharp ſpicula, on the ſtomach: the other, that it has a peculiar action on the nervous ſyſtem. Both theſe theories may contain, perhaps, ſome truth; but neither of them are true to the extent meant to be inculcated.

That arſenic acts with great ſtimulating and corroſive power, upon the ſtomach, is certain; but this is by no means all. Suppoſing ſpicula to be as ſharp as their nature will admit, their moſt extreme ſharpneſs will not account for the ſhort time in which death takes place: was the ſtomach torn to pieces, life would not be extinguiſhed in four or eight hours, as it often is from arſenic.

Of the operation of arſenic, or, indeed, of any other power on the nerves, nothing is known. That it acts upon them, as well as on the other conſtituent parts of the ſtomach, may be readily conceived; but there is certainly no reaſon for giving them the excluſive privilege of being injured: the fact is, that the *ſuppoſed* action of the nervous ſyſtem, is the moſt ſpecious cloak ever invented by medical ignorance. It ſaves the phyſiologiſt the trouble of inquiring, and the phyſician the labour of acting: — we know not what it is, and we therefore aſcribe all the unaccountable and unfounded operations of the body, to its influence.

A fair induction from the appearances of the body, and the analogy of theſe appearances to thoſe in ſome other caſes of ſudden death, will afford us a better clue by which to conduct our inquiry, than any hypotheſis, however ſplendidly adorned, and however ingeniouſly defended.

That the action of arſenic is, in the firſt place, violently ſtimulating, whether internally or externally applied, cannot be doubted: it gives the ſenſation of heat to the tongue, without being ſwallowed; and rubbed upon the arm, or the face, it excites redneſs and heat: when ſwallowed, the appearances of inflammation extend as far as it has reached. After death, putrefaction commences in a much ſhorter time, than from any of thoſe common diſeaſes, which are the uſual avenues to the grave.

From moſt of the poiſons, of whatever kind, from ſome of the diſeaſes which occaſionally ſpread devaſtation over the earth, the caſe is the ſame. Animals deſtroyed by vegetable poiſons, perſons who die of the plague, and the more malignant ſpecies of typhus, become putrid in a very ſhort time. Life is extinguiſhed, after a ſhort and violent ſtruggle, ſo completely, that the component parts of the body are diſunited, and melt down into their original particles. In ſome inſtances, this is done without pain; life is even diſmiſſed from the body without a ſtruggle: in others, the conflict is more laborious.—Lauro-ceraſus contains a power, that will extinguiſh animal life in the former way; arſenic, in the latter, on account of its corroſive qualities. It is not, however, in my opinion, unfair to infer, that death, in all theſe caſes, has the ſame general cauſe, from a principle which acts on the body, as it is compounded of various materials; and by its operation on ſome one or other of theſe, ſo deranges the whole, as to render it incapable of retaining life.

Various powers, capable of deſtroying life, may be poſſeſſed of different properties, beſides the eſſential one; and theſe properties will account for the diverſity in the modes of death, from the various poiſons. The corroſive qualities of arſenic, account for the pain and inflammation it excites, while abſtracting the vital principle. Lauro-ceraſus has no ſuch power, and therefore it deſtroys without pain or inflammation. The poiſon that produces the plague, has killed perſons inſtantaneouſly; its more general term of operation, is two or three days, and the ſymptoms it produces are various, according to this term. But in all theſe caſes, there is ſomething in the mode of deſtruction which obviouſly points out the ſame general cauſe;* not as acting merely upon the nerves, nor as acting merely upon the blood; but as diſuniting the component parts of the whole body in ſome manner, ſo as to produce death in a very ſhort time. — What this cauſe is, we cannot explain, becauſe we know not how life is joined with the body, in all caſes. — Upon this ſubject I can only advance ſome obſcure ſuggeſtions.

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* *Thucydides* obſerves, that as the plague of Athens firſt broke out in the Piræus, it was ſuſpected, "that the Peloponneſians had thrown poiſon into the wells." The violence of the ſymptoms, as deſcribed by the ſame author, is in many reſpects ſimilar to that of the ſtimulating poiſons, and gives a colour to the opinion. —"They were ſeized with burning heats in the head, bloodſhot redneſs of the eyes, and violent inflammation; the tongue and œſophagus, in the greater part of the patients, were diſtended

Do not poiſons act upon the muſcular fibres, as well as upon the blood and the nerves? Does not the motion and powers of theſe fibres, depend upon their union with oxygene, taken into the body by reſpiration, and diffuſed by the circulation of the blood? Does not the action of poiſons conſiſt in diſuniting the oxygene from theſe fibres ſo rapidly, as to extinguiſh their vitality, before they can have a freſh ſupply? The ſudden extinction of life, in all caſes in which the blood is deprived of oxygene,* and the immediate ſucceſſion of putrefaction, entitle me to make theſe ſuggeſtions; and give ſome colour to an opinion, which an enlightened and reformed ſyſtem of phyſiology will, perhaps, ſome time or other, ſatisfactorily explain.

For

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ed with blood; with a hiccup that gave them ſtrong ſpaſms and convulſions, &c."

Aretæus remarks this ſimilarity. — Morb. Acut. lib. i. c. 7.

Compare *Lucretius*, lib. vi. l. 1143, &c.

[*] As when animals are expoſed to mephitic air, &c.

For attributing the action of arſenic *ſolely* to the nerves, there is no one ſhadow of reaſon: on the contrary, the experiments of *Fontana** prove that poiſons have no effect on the body, when applied *ſolely* to them. Nor have the experiments of *Galvani* or *Volta*, hitherto added much to our knowledge of the nerves: we before knew that they were capable of conveying the ſtimulations of the will, or of acrid ſubſtances, to the muſcular fibres; and the experiments with two metals, only afford a more extenſive illuſtration of this important fact, *in ſome unknown power*,† on whoſe properties we muſt pauſe, till better acquainted with its laws and relations to animal bodies.

Nor can I agree with *Fontana*, in aſcribing the action of poiſons ſolely to the change they produce in the properties of the blood. Frogs, it is well known, retain a portion of vitality for many hours after their hearts are cut out; and yet, when they are placed in poiſons without their hearts, the remains of life are inſtantly deſtroyed. Perhaps it may be urged, on my own grounds, that poiſons

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* On the poiſon of the viper.—Vol. ii. p. 130. 148.

† The ſimilarity between Galvaniſation and electricity, is in my mind not yet diſtinctly proved: the reaſon for this belief, I derive from the power of ganglions to impede the progreſs of the animal electricity, as it is called. But it is not my intention to employ my ſickle in a field which has already yielded ſome fruit, and which promiſes ſo rich a harveſt to the careful and induſtrious labourer.

act by decompoſing the blood, and *thereby* prevent the muſcular fibres from receiving that oxygene, which is the pabulum of vitality. But the experiments on animals alluded to before, in which the circulation was deſtroyed, ſeem to prove, that vitality may be acted upon by means independent of the circulation, and hence I conjecture, that the muſcular fibres of the whole body are affected by ſome communication which is pervious only to poiſons. In ſome caſes, (as from laurel-water, and the miaſmata of the plague,) this communication is ſo inſtantaneous, as to deſtroy every portion of life without a ſtruggle: in others, the communication is more ſlow, and life is deſtroyed, after a certain interval, unequally, in different parts of the body; hence the convulſions that enſue, are the laſt efforts of expiring nature, to reſtore the juſt balance of the moving powers.

The indications of cure, when arſenic is taken into the body, are two: — to diſcharge the poiſon; to correct it, and to ſhield the ſtomach and inteſtines from its acrimony. The firſt intention ſeldom can be expected to ſucceed, when the poiſon has been long in the ſtomach, as probably a quantity ſufficient to produce the worſt effects, will be acting on the general ſyſtem, before any long time has elapſed. Yet, in all caſes, it will be proper to give an emetic, or cathartic, with the view of diſcharging it, as the effects of the quantity that does act upon the ſyſtem, may be eſſentially aſſiſted by any particles of the poiſon that ſtick in the folds of the ſtomach and inteſtines. When the poiſon has been taken but a ſhort time, there cannot be any doubt about the attempt to diſcharge it. This is beſt done by emetics, and ſuch large quantities of warm fluid, as will excite nauſea. The time which ipecacuan takes to operate, is too long for it to be uſed alone, with any ſucceſs; recourſe, therefore, ſhould be had to the more ſtimulating emetics. Vitriolated zinc, or tartariſed antimony, beſt anſwer, in point of quickneſs of operation, and they may be uſed in large quantity, without fear: along with them, ipecacuan may be given, as it will continue the irritation begun by the more active emetics, and render the diſcharge of the poiſon more certain.*

If the time ſince which the poiſon was taken, authoriſe the ſuſpicion of its having proceeded to the inteſtines, the ſtimulating cathartics, ſuch as ſcammony and calomel, may be given, with warm aqueous liquors, which, in all caſes of corroſive poiſons, may be uſed with advantage, as they will not

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* As the action of the ſtomach is generally excited to ſo great a degree, as to prevent the full diſcharge of its contents, in thoſe caſes, the evacuant medicines will be much aſſiſted by ſmall doſes of opium, with copious draughts of an infuſion of muſtard in warm water.

not only ſerve to diſcharge them, but alſo, by diſſolving the poiſons, to ſheath the alimentary canal from their acrimony. Indeed, from the firſt moment of ſuſpicion that poiſon has been ſwallowed, warm aqueous fluids ſhould not be ſpared. Upon no medicines can we place greater dependance for ſheathing the inteſtines, than theſe, which include mucilages of gums, broths, milk, and even warm water: there can hardly be exceſs in adminiſtering them. Oils are not ſo proper, as they do not diſſolve arſenic.

For correcting the poiſon, all the preparations of ſulphur, particularly thoſe that are called liver of ſulphur, and the flowers, are peculiarly appropriate; with theſe, mild alkali[*] may be given in conſiderable quantity.

For external application, waſhes, with the ſolution of liver of ſulphur, and warm baths, impregnated with ſulphur and alkali, are uſeful; particularly when the poiſon has been long in the habit, and when the virulence of its operation begins to abate. But all theſe correctives are quite ſecondary objects; the firſt care ſhould be to expel the poiſon from the body, if it be poſſible, as we cannot depend upon the ſucceſs of attempts to correct it.

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[*] The baths of Carſb-bad, which have been uſeful in curing arſenical diſeaſes, contain aerated mineral alkali. —*Bergman's* Eſſays, vol. ii. p. 307.

I do not mean to inſinuate, that the correctives ſhould be neglected, far from it; but only to recommend the previous uſe of thoſe medicines, which will tend to diſcharge the poiſon from the body. If the hepar ſulphuris, and the other preparations of ſulphur, can be adminiſtered at the ſame time, it will be well to adminiſter them. But we ſhould never ſuffer ourſelves to be deluded with the hope of correcting the poiſon, when it is in our power to expel it.

When the poiſon was applied externally, correctives muſt be applied with double vigour: but even in this caſe, the uſe of diluents ſhould not be neglected. It is not eaſy to fix ſo preciſe a method of cure, as ſhall be ſerviceable in all caſes. In general, however, when the poiſon has been ſwallowed, the plan I have laid down, ſhould be ſtrictly followed: and for external application, the correctives ſhould be tried to their utmoſt extent, with the moderate uſe of evacuants and diluents.

When the immediate danger is over, our care ſhould be directed to prevent the train of diſeaſes of debility, that too frequently follows. With this view bark, nitre, and tonic medicaments, ſhould be adminiſtered, according to the nature of the ſymptoms.

Into ſo wide a field, the limits of this eſſay will not ſuffer me to enter farther; and I ſhall content myſelf on this head, with tranſcribing a caſe from *De Haen*,* that contains a good and ſucceſsful method of cure. I do not inſert it to recommend the braſſica rubra in particular, but as an admirable illuſtration of the arſenical diſeaſes.

Arſenici albi terribiles recenſere juvat effectus. Hortulani in proximo pago *Penſink* uxor, nunquam adhuc gravida, ſaniſſima tamen, ac toroſa mulier, menſe Julio anni 1763. emerat pro ægrotante quopiam puero, pulveres duos *Cremoris tartari*, & *Lapidum cancrorum*, eorumque uno puero dato, alterum in menſa repoſuerat. Ipſa vero a prandio minus recte ſe habens, ſumpſit, ut putabat, hunc alterum pulverem.

Notandum eſt feminam hanc, antequam pulverem ſumeret, præ enormi ſiti immaniter aquam gelidam bibiſſe; prætereaque pulverem una cum ingenti aquæ copia aſſumpſiſſe: ita ut copioſo cum veneno, antidotum quoque ſumpſerit copioſum.

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* Ratio Medendi, vol. iii. p. 113, &c.

Cum valida ventris tormina pati inciperet, petiit lectum, nauſeavit, elapſa autem ſemihora vomuit. Interea temporis redux domum maritus, videt uxorem vehementer vomentem, & anxiam eſſe. Igitur percunctari ille quid geſtum, quidve aſſumptum ſit? Dum vero inaudit pulverem hunc, quem in menſa mane ſe repoſuiſſe uxor ajebat, aſſumptum ab illa eſſe, mox territus hic ad menſam accurrere, & miſerando ejulatu vociferari, pharmacopæi pulverem in menſa reperiri, ejus vero loco aſſumptum pulverem *Arſenici albi*, quem ad mures necandos emtum, eadem in menſa incogitanter repoſuerat. Vocatus actutum Medicus, oleo & lacte corpus laudabiliter implevit; unde vomitus, qui per multas horas plus centies erupiſſet, paulatim ceſſavit.

Porro mirabatur femina quod, vomitu ceſſante, ſe tam belle haberet, quemadmodum etiam die altero tertioque. Quarto vero die pedes invaſit, qui dicitur *crampus*, craſſaque plantarum pedum epidermis tota ſeceſſit. Qua dein recreſcente, incedere, præ ſumma ejuſdem teneritudine, dudum non potuit. Juſſa eſt *Badenſia* Balnea ſulphurea adire, menſiſque hiſce uti ſpatio. Catamenia ſubſtitere in balneo. Multaque ibidem Medicamenta ſumſit. A Balneo crurum ipſi ſenſim impeditior motus, ſic ut primum ingenti cum labore, tardiſſimeque, paſſus quoſdam ederet, ab ineunte vero

Septembri cruribus movendis ultra non eſſet; manuumque, ac brachiorum fere omnem motum amitteret; humeris ſolis, ac femoribus nonnihil adhuc obſequioſis. Jamque univerſo de corpore, caput ſi exceperis, epidermis ſeceſſit. Poſtmodum autem motus exiguus muſculis manuum rediit, ut ſiniſtro leve quid, chartam v. c. tenere, dextro digito nonnihil, ſed obſcure, ut vix advertiſſes, movere poſſet. Binis vero hominibus ſuffulta, crura ne hilum quidem movere potuit. Quodque in paralyticis nonnunquam adverteramus, ut jacentes artuum inferiorum ſuperiorumque motum quemdam, qui ſedentibus iſtis impoſibilis, ederent; hæc ne vel minimum quidem. Attraxit utcunque crus, & brachium, levi illo motu, quem dixi humeris femoribuſque ſuperſtitem fuiſſe, haud vero movit. Intolerabilis acceſſit crurum, pedumque, pruritus, qui in aliis boni ſæpe auguri, in hac vero minime. Interea pulſus, appetitus, ſomnus, alvus, urina, bona; quique in balneo ſubſtiterant, rediere menſes. Multis, iiſque præſtantiſſimis remediis incaſſum uſa, inducta demum in Noſocomium noſtrum eſt, ineunte Novembri anni 1763.

Datis, ut monui, incaſſum ſelectiſſimis remediis, animum mihi ſubiit vires explorare, cum aliis vulnerariis, *Braſſicæ*, cui *Otto Tachenius*, vapore *Arſenici* captus, curationem ſuam magnam partem adſcripſit, poſtquam lacte & oleo a præſenti periculo vindicatus primum eſſet; in *Hipp. Chem. Cap.* XXIV. ſumpſit itaque femina bimeſtri ſpatio hoc decoctum: ℞. Tarax. rec. cum toto unc. ß. Braſſicæ rubræ Lib. j. Pulv. Sarſap. unc ij. Glycyrrhi. unc. iij. coq. aq. p. per horam. Colat. Menſ. j. ß. D. u.

Cardialgia ex acore manifeſto vexata aliquoties fuit, ſed mox reſtituta uſu miſturæ, paratæ ex aqua ſambuci, ſyr. diacod. & lap. cancr. Semel autem febris, cardialgiam concomitans, remedio huic haud obedivit amplius, ſed cephalalgiam adjunxit, & tantillum illud, quod ſuperat, motus, proſtravit. Cogebamur tunc cortice peruviano eandem fugare; haud multo tamen; cum paucos intra dies febris, ſuis cum ſymptomatibus, fuſa, fugataque eſſet.

Spatio bimeſtri hac methodo Paralyſin, ac pruritum, doloremque nihil emendavimus. Unde robur nervis cortice peruviano conciliare annitebamur, interea dum crura manuſque nunc aqua vulneraria, nunc pulveris aromatici fumo, bis die fricarentur. Vis dein electrica, quotidie ſemel adhibita, levem quidem emendationem fecit, ut crura utcunque plus attrahere, ac digitorum manus ſpectabiliorem, pediſque dextri obſcurum, qui nullus fuerat, motum edere poſſet; at vero tandem corpore ad lecti crepidinem ſuffulto, crura ac pedes immiſimus in balneum, uſque ſupra genua, aquæ calidæ, cui flores chamomillæ, flores ſambuci ac lavendulæ intabuerant: dum interea corpus repleretur decocto Tarax. Naſturt. Sarſap. Glycyrrh. Effectum hinc, ut decurſo menſis horum in uſu ſpatio, gradi inciperet, cum iiſdem deinceps pergendo ambularet, digitos nendo exerceret, ac tandem menſe Junio domum, quo aere ruſticano frueretur, peteret, & ſæpius inde ad me pedes venerit; ob reliquias mali ejuſdem remedii novam formulam petitura.

Quæri a me poſſet citiuſne curata hæc femina fuiſſet, quando, vel antequam meæ curæ ſubjiceretur, vel ſaltem cum eidem ſubjecta eſſet, ultima meæ methodi parte tractata fuiſſet: indicante nimirum pruritu illo dolorifico acredinem, aut veneni reſiduam, aut veneno genitam, ante oſtia cutanea morantem, ſuique per eadem expulſionem flagitantem? Ægre ſane quæſtionem hanc non fero. Innui braſſicæ vires, *Tachenio* autore, me explorare voluiſſe, vireſque deinde electricas. His ſcopo non reſpondentibus indicationem, de qua quæſtio agit, ſecutus ſum; in ſimili poſtmodum offerendo mihi caſu ab ultima indicatione incepturus curam, quo conſtare poſſet num & citra auxilia diluentia, ſaponacea, ac ſolventia, aut venenum aut veneno genita materies, æque feliciter expelli poſſet. Interim haud diſplicuiſſe lectoribus opinor, hanc integram communicando hiſtoriam, qua non curam duntaxat,

ſed una contueantur mirabundos *Arſenici albi* effectus. Quod ipſum copia enormi, ſcrupuli certe pondere graviore, aſſumtum, primum quidem abundantiſſima, quam tam mox ante, quam una cum illo ſumſerat, aqua; deinde vero ſaluberrimo conſilio medici præſtantis oleo & lacte, ſic viribus inerme redditum eſt, ut neque necaverit feminam, neque hoſpitatum diu in primis viis fuerit, ſed his cæteriſque relictis extremorum artuum Paralyſin, epidermidis univerſæ receſſum, perpetuumque cutis pruritum, dolentemque eundem, generaverit.

For this quotation, long as it is, there is no neceſſity for apology; ſince it is written by a phyſician celebrated for his perſpicuity and accuracy, and ſerves to illuſtrate the chain of ſymptoms ariſing from arſenic, and their cure.

We proceed next to the mercurial poiſons.*

2. MERCURY.

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* Mercury was not known to the ancients as a poiſon, although it was ſo much ſuſpected, that *Galen* was afraid to uſe it as a remedy. The æra of its firſt diſcovery, was probably that of the firſt commerce with Spain, a country which abounds with this mineral, and which *Horace* characteriſes as fruitful in poiſons.

——————— Atque Iberia
Ferax Venenorum.
Epod. v. 22.

We may judge what they knew, and what they thought of mercury, by the following quotations.

Sed

2. MERCURY.

IN its crude, or fluid ſtate, mercury is inert: it becomes active only by combination.

Of its active preparations, the powers are various; ſome of them being moſt virulently poiſonous, whilſt others are nearly innoxious.

To the firſt claſs, belongs the corroſive ſublimate, or mercury combined with oxygenated muriatic acid, and, at ſome diſtance in point of virulence, the preparations of mercury with nitrous acid, called red precipitate, &c. &c.—To the ſecond,

Sed ferro, lapideque ignito, ea quæ per eroſionem interimunt medicamenta, ſimilia ſunt, ad hæc Arſenicum Hydrargyrus.—*Galen* de Simpl. Med. fac. lib. iv. c. 19.

Hydrargyrus non eſt a ſponte naſcentibus medicamentis, nullum autem ejus feci periculum, nec quod interimat ſi devoretur, neque ubi foris admotus ſit.—*Galen* in eod. lib. ix. c. 71.

Hydrargyrus——potum vim pernicialem habet, *ſuo enim pondere* interna exeſt.—*Dioſcorides*, lib. v. c. 60.

Argentum vivum, eadem quæ ſpuma argenti inducit.—*Paul Ægineta*, de Re Med. lib. v. c. 63.

The plain inference is, that they knew nothing of the matter. *Galen* confeſſes he never tried it, and *Dioſcorides* attributes effects to it, which never take place from the crude mineral. Its aſtoniſhing powers were diſcovered, by the abſurd attempts of the alchemiſts.

For an hiſtory of mercury and its preparations, vid. *Ehrman* Diſſ. in *Sandifort Theſaur.* vol i. p. 541.

cond, all the other preparations, placing vitriolated mercury, and calomel, at their head.

Corroſive ſublimate,[*] is a ſure poiſon from two to ſix grains; and even in the quantity of half a grain, it has been known to produce very alarming effects. When taken internally, its operation, in many reſpects, is ſimilar to that of arſenic: the ſame heat and corroſion are felt in the œſophagus,[†] but probably in a greater degree: theſe are ſucceeded by exceſſive pain of the ſtomach, thirſt, and ſickneſs. Purging, as well as vomiting, and often of blood, is a more uſual conſequence of corroſive ſublimate, than of arſenic, and is, therefore, one of thoſe ſlight marks of diſtinction to be attended to. A profuſe flow of ſaliva, and ſwellings of all the internal parts of the mouth, afflict the patient, who is tormented at the ſame time with great anxiety, trembling of the whole body, and difficulty of breathing: to theſe ſucceed the convulſions, cold ſweats, &c. which attend almoſt all acute diſeaſes at their cloſe.

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[*] *Mead* is very unſatisfactory in his account of this poiſon, for as ſoon as he has quoted one inſtance of its effects on a dog, from *Wepfer*, he flies off in a very deſultory inquiry, how, from ingredients ſingly innocent, ſo miſchievous a compound can reſult.—*Mead* on Poiſons, p. 191.

[†] Eroſionis ſenſus in œſophago.—*Lieutaud* Hiſt. vol. i. p. 33.

Magnam ille roſionem in œſophago ſtatim perſentit.—*Boneti* Anat. Pract. lib. iii. obſ. 4.

Many caſes of the effects of corroſive ſublimate, may be ſeen in *Morgagni* de ſed. & cauſ. lix.

On diſſection, every part of the œſophagus, ſtomach, and inteſtines, touched by the poiſon, is found corroded, inflamed, and mortified. The corroſive power is greater than that of arſenic, conſequently the miſchief done is more apparent. If the corroſive ſublimate has proceeded to the ſmall inteſtines in any quantity, the parts below it, will be found contracted ſo as almoſt to ſhut up the paſſage of the inteſtine: this has been the caſe likewiſe with the œſophagus, when the poiſon has been attempted to be ſwallowed undiſſolved.*

Corroſive ſublimate is as deleterious when uſed externally in lotions, unguents, or powders, as when ſwallowed. The ſymptoms are nearly the ſame, as when it is taken internally.

† "A woman, to whom corroſive ſublimate was externally applied, in the form of a plaſter, was ſeized with intolerable pains, vomiting, convulſions,

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* A young woman endeavoured to ſwallow two drachms of corroſive ſublimate, undiſſolved in any fluid; but from the extreme irritation of the poiſon, the œſophagus ſo cloſely contracted, as to prevent its paſſage into the ſtomach. She did not confeſs what was the cauſe of her calamity, till ſeveral hours after ſhe had taken the corroſive ſublimate; and died on the ſixth day of a mortification of the throat.

† *Plenck* de Venenis, p. 263.

ſions, ſwelling of the jaws, and ſalivation, and died in great agonies."

*[1] "A ſtrong robuſt woman, aged forty-nine, had an ulcerated cancer of the breaſt, on account of which ſhe conſulted an empyric. After being prepared during fifteen days by bleeding, purging, and domeſtic baths, the empyric proceeded to the uſe of a white powder, which conſiſted of corroſive ſublimate. The pains began ſoon after the application, but encreaſed, and at the expiration of four hours became intolerable. All at one time ſhe was attacked with anxiety, nauſea, vomiting, even of blood, convulſions, and at laſt ſhe ſuffered the moſt dreadful tortures in every part of her body, from which ſhe was not delivered by death, till the next morning. On diſſection, no other diſorder was apparent, than an effuſion of reddiſh ſerum, with which the cheſt was nearly filled."

Theſe melancholy inſtances of the abuſe of corroſive ſublimate externally applied, will ſpare me the taſk of enumerating the ſymptoms at greater length; nor indeed have I any thing more to add to this part of the ſubject, than that the term of action will be deferred by this mode of application, and that a larger quantity of the poiſon will be neceſſary to produce fatal effects, than when it is directly taken into the ſtomach. When the quantity applied to the ſyſtem is not ſufficient to produce immediate death, or when fatal conſequences have been prevented by the adminiſtration of remedies, the evil does not always ſtop: a long train of diſeaſes are known to follow its improper and incautious uſe; and phthiſis or palſy terminates life.

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[1] *Pibrac* ſur l'uſage du ſublimé corrosif, in Mem. Acad. R. de Chirurg, tom. xi. p. 245.

The quantity of corroſive ſublimate that may prove deleterious, is much the ſame as that of arſenic; — from two to ſix or ten grains. It is adminiſtered as a medicine, to the quantity of a quarter and half a grain for a doſe, and I believe frequently with advantage: but too much caution cannot be urged, to guard againſt *miſuſe*. Indeed in this caſe, it would be well if the authority of the laws were enforced to check an evil, the extent of which cannot be ſeen. It ought not to be in the power of any unqualified perſons, to diſpoſe of medicines which may be adminiſtered with ſuch facility, and which deſtroy life with ſo much certainty, without the ſignature and authority of thoſe, who alone are authoriſed to diſpenſe them*.

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* And even they will do well to have in mind the ſolemn advice of the great father of their art.—"I will never adminiſter to any perſon any poiſon; no, nor if intreated, any thing of a poiſonous or deſtructive nature — Nor will I aſſiſt in any ſuch conſultation or preſcription." *Hippocratis* Juſjurand.

Corroſive ſublimate does not deſtroy life ſo quickly as arſenic, though, perhaps, in the average number of caſes, there is no great difference. There are no inſtances upon record, in which its operation was ſo ſhort as three or four hours. From ten hours, to thirty or forty, will be the more common term of operation.

The operation of corroſive ſublimate ſeems ſo remarkably analogous to that of arſenic, that what I have ſaid on that head, will be perfectly relevant to this. If we make any diſcrimination, it is, that the corroſive power of arſenic, is leſs than that of corroſive ſublimate, and that the virulent qualities, in which its power as a poiſon more eſpecially reſides, are greater: hence the operation of corroſive ſublimate is not ſo quick. This difference in the term of action, and its diſtinctive operation as a mercurial, are the only marks by which the one poiſon can be known from the other.

Of the action of the mercurials in particular, I can ſpeak with little confidence. I believe, that in a certain degree, it diminiſhes the powers of ſenſibility and life, but whether from an exceſs of ſtimulation, is not eaſily determined. The mercurial medicines promote excretion and ſecretion, and have a particular effect on the ſalivary glands, which is the diſtinctive operation alluded to.

All the authors on this ſubject, mention the ſalivation as one of the moſt remarkable ſymptoms of corroſive ſublimate; and one of them goes ſo far as to ſay, it was ſo certain, that he could renew it at pleaſure.*

Corroſive ſublimate, found in the ſtomach, may be diſcriminated from arſenic, by not giving out the garlic odour when placed on hot coals. For any of the other mineral poiſons it can hardly be miſtaken. If a grain of corroſive ſublimate be added to a ſolution of mineral alkali, in pure water, a red powder will be precipitated.† Aerated, or common magneſia, will ſlowly precipitate corroſive ſublimate, from ſolution in water, as a darkiſh red powder: pure, or burnt magneſia, as a black powder.‡ Theſe chemical teſts will be ſufficient to diſtinguiſh this poiſon, though it be found only in the quantity of a grain or two in the ſtomach; and I have mentioned them, as they may be eaſily tried by any perſon.

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* Il produit ſouvent une ſalivation impetueuſe ſans qu' aucun d'eux ſoit garant qu' elle puiſſe etre moderee par l'art.——La ſalivation renouvella a mon gre.—*Pibrac*, in Mem. Acad. R. de Chir. xi. 349.

† *Bergman* on Aerial Acid, ſect. xxi.

‡ *Black*, on Magneſia Alba.

The cure of thoſe poiſoned by corroſive ſublimate, muſt be undertaken with much the ſame intentions, as if it happened by arſenic: but here we may place greater reliance on correctives.

The indications of cure are: —

1. To diſcharge or correct the poiſon.

2. To ſhield the ſtomach and inteſtines from its acrimony.

I have ſo ſtrongly inſiſted before on the uſe of large quantities of aqueous and mucilaginous liquors, when arſenic is ſuſpected, or known to be taken into the ſtomach, that I ſhall ſay no more on this head, than that they are as neceſſary, and in the largeſt quantities, when corroſive ſublimate has been ſwallowed. They not only anſwer the firſt intention, by contributing to diſcharge the poiſon, but they alſo ſheath the ſtomach and inteſtines, at the ſame time. It may be thought unneceſſary to give emetics or evacuants of any ſort, in caſes where corroſive ſublimate has been taken, on account of the violently ſtimulating properties of the poiſon itſelf, and that we have only to aſſiſt the diſcharge, by the profuſe adminiſtration of liquids. But the fact is, that we muſt never ſuffer poiſons to take their own courſe. Our firſt endeavour ſhould be to diſcharge them, eſpecially ſoon after they were taken; and for this purpoſe we ſhould uſe the moſt vigorous means. Emetics of vitriolated zinc, on account of the ſuddenneſs of their operation, are well calculated, in the firſt place, to anſwer this intention: in the ſecond, recourſe muſt be had to correctives, and their uſe ſhould be perſiſted in with confidence and vigour.

As corroſive ſublimate conſiſts of mercury, combined in a peculiar manner with muriatic acid, and as its poiſonous qualities reſult from the combination, all the means that tend to diſunite them, will moſt eſſentially ſerve for correctives: and they may be uncombined by the addition of any of thoſe ſubſtances which have a greater elective attraction for one or other of the component parts, than they have for each other. The alkalies anſwer this end, by attracting the muriatic acid, and leaving the mercury free.

Of the alkalies, the vegetable has the ſuperior attraction for muriatic acid, it is beſt, therefore, for this purpoſe: next to it comes the mineral alkali. With diluting drinks, ſuch as broths, milk, gruel, &c. &c. one or other of theſe ſhould be poured into the ſtomach, and we need not fear to give them in a very conſiderable quantity.*

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* A boy ſwallowed an ounce of corroſive ſublimate, and had all the bad

I ſhall not enter into any farther detail, with reſpect to the method of cure, of which the caſe below* will ſerve as a good practical illuſtration: nor ſhall I attempt to enumerate, much leſs to deſcribe, all the diſeaſes which are ſaid to ſupervene, when life is not immediately deſtroyed by corroſive ſublimate. The general ſimilitude of this poiſon to arſenic, has induced me to refer a great deal of what might have been ſaid concerning it, to what has been already mentioned under that head: where any difference appeared to exiſt, I have endeavoured to note it.

Nitrated Mercury is ſo corroſive, as to conſume

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bad ſymptoms; yet recovered by the judicious uſe of vegetable alkali.—Com. Norimb. 1735. Hebd. xxx. ſect. 3.

* Innupta quædam fæmina 40 fere annos nata, voravit mercurii ſublimati corroſivi integram drachmam. Ilic correpta eſt neceſſariis ſymptomatibus, calore nempe & cruciatu ſummo ventriculi & inteſtinorum. Pharmacopæus qui brevi poſt adfuit, aquam tepidam atque oleum lini copioſiſſime in gulam ejus ingeſſit, ut veneni partem educeret ventriculo, ant ſaltem dilueret atque obtunderet. Poſt horas aliquot ad ægram ego ſum accerſitus. Hauſtum præſcripſi ſexta quaque hora ſumendum, qui olei amygdalarum dulcium atque aquæ alexeteriæ ſimplicis ſingulorum unciam unam, cum mannæ drachmis tribus habebat: cui poſt tres horas, perpetuo interponendum erat enema ex olei amygdalarum dulcium tepefacti unciis quinque. Tum idoneis intervallis præcepi in juſculum ovinum, ut copioſe inſtillaretur lixivium tartari, atque ita frequenter epotaretur-fore enim ſperavi ut ſal illud alcalinum cum mercurio corrosivo in inteſtinis commiſſum ſalia cjus acida ad ſe arriperet, et mercurium crudum & fere innocuum redderet. Quod ex ſententia ſucceſſit. Poſtquam enim per duodecim dies in hoc regimine perſtitiſſet, ab omni dolore & periculo liberata eſt.—*Akenſide* de Dyſenteria, p. 43.

all animal ſubſtances it touches, though applied to them in the ſmalleſt quantity. On the ſkin, it produces purple ſpots, which form ſcales, and fall off; if it is not exhauſted by this operation, it goes on conſuming the texture of the part, till it is all decompoſed by the proceſs of corroſion and conſumption.

Taken into the ſtomach, all the preparations of nitrated mercury are capable of deſtroying life, when they are applied in ſufficient quantity. as they are capable of deſtroying the organization of the part. The ſymptoms they produce, are thoſe of moſt violent active inflammation;[*] exceſſive pain and ſickneſs in the ſtomach, with dreadful ſpaſmodic affections of that and the neighbouring parts, and frequently bloody diſcharghes by ſtool, as well as vomiting. This inflammation proceeds to mortification, when faintneſs, hiccup, anxiety, and cold ſweats come on, with convulſions. — Salivation is a characteriſtic ſymptom of all the mercurial poiſons, and occurs more or leſs when any of them have been taken to exceſs.[†]

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[*] The inflammation from a corroſive, or from the common exciting cauſes, cold, &c. will be different, inaſmuch as the exciting cauſe is more violent, and is continually acting, till it deſtroys even the texture of the organ. Hence the pain will be more ſevere, and the efforts to caſt off the exciting cauſe will be greater.

[†] Fœminam ab aſſumpto mercurii præcipitato quem empiricus aliquot diebus

On diſſection, the ſtomach, and all the parts touched by the poiſon, will be found inflamed and mortified, and ſome of them corroded. Strictures ſometimes are formed in the parts below the poiſon, owing to its violent ſtimulations.

Externally applied, the danger is not the ſame, as it muſt be uſed, to produce any very alarming conſequences, in ſo large quantity, as to give ſufficient warning to the patient: yet may it be applied to ſome organs, ſo as to render life of little value, though it may not endanger its continuance. A ſmall portion will deſtroy an eye, or make ſuch apertures and wounds in other parts, as to leave little comfort ever after. I have ſeen, more than once, very troubleſome inflammations of the abſorbent veſſels of the leg and thigh, with a chain of abſceſſes along their courſe, ariſe from its application to ſores of the leg.*

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diebus ad ſex gr. cum pauco potu obtulit, horrendis ſpaſmis fuiſſe affectam & tandem mortuam. Sectione facta multæ rubræ maculæ in fundo ventriculi, duodeno & jejuno repertæ fuerunt; ventriculus tumefactus, portio vero jejuni artiſſime conſtricta fuit.—*Hoffman* de infec. Med. tom. vi. p. 313.

* Ce medicament (Principite rouge) cauſa une flux tres considerable de bouche. Les commiſſaires diſoient, que ce fait n'etoit pas nouveau, & qu'il devoit ſervir a rendre les Chirurgiens circumſpects dans l'application des remedes topiques dont quelques unes peuvent etre tres nuisible & dangereux.—Mem. Acad. R. de Chir. xi. p. 249.——Vide *Hildani* Obſ. Chir. Cent. v. Obſ. 94.

Notwithſtanding its corroſive qualities, nitrated mercury has been given internally, in ſmall doſes; but ſeldom without pain and uneaſineſs. In the quantity of two or three grains, the mucus of the ſtomack may envelope it, and reſiſt its acrimony; but even in this quantity it is to be feared. From ſix grains, in the caſe cited before, death was produced. The circumſtances of the ſtomach at the moment, and whether fluids were taken with it or not, will very materially alter the caſe. If the ſtomach be empty at the time, and little or no fluid be given with it, bad conſequences are much more likely to enſue.

We have no data upon which to ground our determination, in what time nitrated mercury will produce its effects. Inflammations of the ſtomach have been known to terminate in death in eighteen hours* from their firſt appearance. From this time, therefore, to three or four days, we may conclude will be the general average.

If nitrated mercury be found in the ſtomach, it may be diſcoverable by precipitants; but its forms will be various, according to the modes of the ſolution.† The exiſtence of the nitrous acid is always diſcoverable, by the ſubſtances in which it is an ingredient, giving out red fumes, when expoſed to heat. From corroſive ſublimate it may be diſtinguiſhed, as mineral alkali will precipitate it, in the form of white clouds. From nitrated ſilver, by mixing it with a ſolution of ſea ſalt, which will cauſe a ſmall precipitation from nitrated mercury, but a moſt copious one from nitrated ſilver. From arſenic, the garlic ſmell of the fumes will diſtinguiſh it, and, indeed, the duration of the ſymptoms. From the other poiſons, the diſcriminations will be marked under their different heads.

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* *De Haen* de poſſibili termin Inflam.

† *Bergman* on the Analysis of Waters, vol. i. p. 135.

The operation of nitrated mercury, is probably the ſame as that of all the other corroſives, that have no other ſpecifically poiſonous quality. They all act on a principle ſimilar to that of combuſtion. It is now tolerably well aſcertained, that the phenomena of inflammation and combuſtion, ariſe from the decompoſition of a part of the atmoſphere, which was termed by its diſcoverers, dephlogiſticated, or vital air, but which modern chemiſts have agreed to call oxygenous air. During this proceſs, the different component parts of the oxygenous gas, are let looſe, ſome of them in the form of light and heat, while others are combined with the baſe of the ſubſtance burnt. Infinite are the varieties of combination, from the modes and the ſubſtances employed. In ſome, the oxygene is firmly united to its baſe, and is ſeparated from it with very great difficulty: with others, it is ſo looſely connected, as to give itſelf out upon the firſt application of any ſubſtance having a ſtronger attraction for it. This is the caſe with the corroſive poiſons. The oxygene they contain, has a much more feeble attraction for them, than it has for animal matters: hence, when the latter are applied, it is poured into them with ſuch amazing velocity, that an actual combuſtion, and conſequent decompoſition of parts, takes place, organization is deſtroyed, and the vitality of the whole body ſuffers, in proportion to the importance of the functions of the impaired organ.

For the cure of thoſe poiſoned by nitrated mercury, we muſt have recourſe to nearly the ſame means recommended in the caſe of corroſive ſublimate. The poiſon ſhould be diluted with very copious draughts of mucilaginous and aqueous liquors, and then diſcharged by the operation of an active emetic, ſuch as vitriolated zinc. Alkalies may be uſed, with great advantage, as correctives, indeed, they are ſovereign remedies in this reſpect, when an acid forms part of the noxious compound.

Preparations of ſulphur may alſo be ſerviceable, when alkalies are not at hand, but they are never to be relied upon ſolely. — Calcined magneſia has been recommended, and is an uſeful medicine in theſe caſes, chiefly to be employed, when the poiſon is ſuppoſed to have reached the inteſtines, but never ought to make us undervalue the alkalies, or be ſuffered to ſuperſede them. After the immediate danger of the poiſon is paſt, great debility of the organ affected, frequently remains: this muſt be remedied cautiouſly, by ſtimulants adminiſtered gradually, and in proportion to the ſtrength of the patient. No better rule of practice can be given, than that which is uſually followed in the decline of active inflammation. When the inflammatory ſymptoms are entirely abated to apply ſuch moderate ſtimulants, as ſhall prevent the other extreme, an entire loſs of action.

Vitriolated Mercury, or turbith mineral, is a moſt active emetic and cathartic, in the quantity of ſeven or eight grains. From the other mercurials, and from arſenic, it will be diſtinguiſhable, as not poſſeſſing their corroſive qualities. If however, it be taken in the quantity of a ſcruple, and from that to a drachm, it will produce violent pain of the bowels and ſtomach, with inceſſant vomiting and purging, which, if not ſoon remedied by diluents and alkalies, will be followed by inflammation, mortification, and death.[*]

Calomel, mercurius dulcis, and ſome other preparations of mercury, are active alſo, in doſes of four or five grains, and have been known to produce very terrible conſequences when they were taken to the quantity of a drachm, and in ſome caſes, of a few more grains than uſual.

" A healthy boy, fifteen years old, took fifteen grains of mercurius dulcis, well prepared: immediate vomiting followed, with anxiety, reſtleſſneſs, and tremors of the feet and hands, and finally, with a contraction of the hands. He died on the 6th day."[†]

" To a boy of twelve years old, fifteen grains of mercurius dulcis were given for a doſe. Anxiety, a vomiting of black matter, and death, were the conſequence."[‡]

" One who took by accident half an ounce of mercurius dulcis, died within twenty-four hours.[||]

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[*] Helvigius a Turpetho minerali tormina, & anxietates ſpectavit.—*Hoffman*, tom. vi. ex—Miſcel. Nat. curios. Dec. 3. an. 8. obſ. 7.

[†] *Hoffman* de inſec. Med. tom. vi. p. 314.

[‡] Ibid.

[||] *Hoffman* ex Miſcel. Nat. cur. Dec. 2. an. 10. p. 20.

Theſe caſes ſerve to illuſtrate the ſymptoms, and the quantity of the poiſon which will produce them;* and we may judge, that they would be nearly the ſame from vitriolated mercury, as from mercurius dulcis. In one caſe, life was terminated in twenty-four hours; from this time, therefore, to three, five, or ſeven days, may exiſtence be prolonged.

In all caſes, the ſtomach will be found inflamed and mortified, but not corroded by the mercury. When there are corroſions from a mercurial, corroſive ſublimate, or nitrated mercury, ſhould always be ſuſpected.

The actions of theſe preparations of mercury can eaſily be explained, by ſuppoſing that their ſtimulating properties produce inflammation of the ſtomach, which is too apt to proceed to gangrene. There may exiſt ſome noxious operation, peculiar to them as mercurials; but however this may be, their other powers will be ſufficient to account for the evils they produce.

The cure, muſt be attempted by diluents, very copiouſly adminiſtered, by diſcharging the noxious ſubſtance by emetics of vitriolated zinc, and by the uſe of alkalies, and preparations of ſulphur.—
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* Mangeti Bibl. Med. Prac. lib. xxiii. p. 825.

There is little variety in the general rules of cure, in all the caſes of mineral poiſon: much muſt be always left to the particular exigency of the caſe, and to the good ſenſe of the practitioner.

Mercury is not only hurtful in theſe more compounded ſtates, but is capable of being extremely deleterious, when combined in the moſt ſimple way with the pure part of the atmoſphere, and applied in the form of fume to the bodies of animals.

" *Fallopius*, de metallis & foſſilibus, affirms, that few of the workmen live more than three years in quickſilver mines: and *Etmuller*, in his mineralogy, that they are ſeized with tremors, palſies, and vertigos, in the courſe of four months. In the tranſactions of the Royal Society of London, a letter from Venice informs us, that none of the workmen in the quickſilver mines in the Forum Julii, are able to labour more than ſix hours at a time. One of the workmen in theſe mines was ſo impregnated with quickſilver, that if he handled braſs, or put it into his mouth, it became white. *L. Tozius* obſerves, that the workers in quickſilver are apt to be troubled with aſthma, and their teeth fall out."*—In the town of Birmingham, I have had many opportunities of obſerving the diſeaſes of gilders, which ariſe from quickſilver; and I am likewiſe indebted to Dr. *Edward Johnſtone*, of that town, for much information on the ſame ſubject.

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* *Rammazini* de Morb. Artificum. c. 1.

The proceſs of gilding, conſiſts chiefly in the amalgamation of gold by mercury, in placing this amalgam on the metal to be gilded, and then, in ſeparating the mercury from the gold, by heat, and thus leaving the metal roughly gilt. It is in this laſt proceſs, the evaporation of the mercury, that the workman is liable to injury. Hence, if his body be expoſed to the fumes of the metal, either by a current of air, by chance, or by negligence, he is ſure to ſuffer.

All thoſe who are engaged in any other proceſſes of mercury, with heat, are equally expoſed to the bad conſequences; as mercury riſes in vapour, or boils, at the 600 degree of *Fahrenheit*'s thermometer.

The moſt uſual ſymptoms of this mercurial diſeaſe, are, firſt of all, languor and laſſitude, with pain of the head, dimneſs of ſight, nauſea, and acidity of the ſtomach, and vomiting, which generally affords much relief; ſometimes pains of the bowels, and coſtiveneſs, followed by diarrhœa, which, like the vomiting, is for the moſt part ſerviceable, and often entirely carries off the diſeaſe. But if the patient ſtill continues his employment, and more particularly, if he is intemperate in drink, or debilitated by depreſſing paſſions, or any other cauſe, theſe ſymptoms are likely to return in an aggravated degree. He is attacked by aching pains in every part of his body, with agitation and tremors of the hands, at firſt ſlight, but gradually encreaſing, and extending to the arms, neck, and face, and ſo to the whole body, and which become at laſt ſo violent, as to prevent the ordinary exertions of the voluntary muſcles. In ſome caſes, the muſcles of reſpiration are ſo much affected, as to produce anxiety, with great oppreſſion of the breaſt: the pulſe is generally weak and low: the inteſtines are affected with ſpaſms, attended by coſtiveneſs, which often encreaſes to obſtinate conſtipation: the extremities are cold, and the whole body exhibits ſymptoms of failure of the powers of life. The teeth are commonly looſened; and ſalivation comes on, which, though a frequent attendant of the diſeaſe, is by no means regular in its acceſſion, as it full as often precedes, as follows the paralytic ſymptoms. If occaſioned by a ſudden *bluſh* of the vapour upon the operator, its acceſſion is immediate; but in ſuch caſes, the ſhaking, and other paralytic ſymptoms, have not been obſerved.

When the diſeaſe ends fatally, its terminations are various: ſometimes by palſy, and ſudden death; at others, by conſtant and inſuperable diarrhœa. Frequently is life terminated by dropſical effuſions in the different cavities of the body; and now and then by a fever, moſt reſembling typhus, from which, if the patient recover, the recovery of his ſtrength is remarkably ſlow, though the paralytic ſymptoms ſoon diſappear.

Beſide the above, gilders are often ſubject to aſthmatic and phthiſical complaints, which ſeem to depend on the loſs of action of the parts concerned in reſpiration, not on inflammation or ulceration. — Women are not ſo liable to be affected by theſe diſorders as men; and thoſe of the ſanguine temperament, and who are inclined to corpulency, are leſs liable than lean, weak, and irritable perſons: but of all, the naſty and intemperate, are moſt ſubject to them.

Mercury, when applied externally, in the form of ointment, has never, as far as I know, produced the dreadful diſeaſe before deſcribed. — I have known two drachms rubbed into the thighs, every night, for a fortnight, and no bad effects followed, not even ſalivation. Dr. *Gregory* uſed to relate the caſe of a gentleman in his lectures, who rubbed in an ounce of mercurial ointment daily; he was not ſalivated, but much oppreſſed. — There ſeems, therefore, to be a remarkable difference in the operation of mercury, when it is applied by fume to the body, and when its particles are abſorbed, after being rubbed down by ſimple triture. The combination with oxygene in large quantity, in the form of fume, is probably the cauſe of the difference. Mercury, by this combination, becomes more poiſonous, as in the caſe of its addition to the oxygenated muriatic acid, and according to the mode and the circumſtances of its application, equally capable of abſtracting the vital principle.

The fumes of mercury have been known to kill inſtantaneouſly. From the circumſtances of their operation however, their effects are generally chronical: as the operator is not always expoſed to them, the diſeaſe is gradually introduced, and does not ſhow its virulence till after two or three weeks. Some perſons employed in gilding, have eſcaped for years; and ſome who have uſed peculiar caution, have entirely eſcaped. This laſt circumſtance ſhould be an encouragement to the manufacturer to employ all the means in his power to avoid the fume, as he is ſure to be rewarded. I believe, many of the workmen in Birmingham interpoſe a plate of tin, between themſelves and the pan in which they ſhake the gilding metal, through which they are enabled to ſee by means of a piece of glaſs; and ſome ſhake the metal in a kind of cage. Other contrivances may eaſily be invented and employed, for driving the current of air conſtantly up the chimney, and thus preventing the effects of any ſudden bluſh of fume upon the operator: and ſurely ingenuity cannot be better employed, than in inventing thoſe means which ſhall protect the health, and thereby prolong the lives, of induſtrious and valuable citizens.

The indications of cure are theſe:

1ſt, To diſcharge or correct the poiſon.

2dly, To reſtore the ſtrength of the body; and thus obviate its effects.

In the firſt ſtage of the mercurial diſeaſe, its deleterious effects are frequently obviated by a ſpontaneous effort of nature, by vomiting or diarrhœa: this effort ought to be encouraged or imitated, by ſuch medicines as will operate freely, though mildly. Ipecacuan, caſtor oil, and flowers of ſulphur, are of this number, and hence are beſt adapted for the purpoſe. When a ſufficient diſcharge has been procured, the lower parts of the body may be bathed in warm water, and a gentle diaphoretic, ſuch as a few grains of the compound powder of ipecacuan, be adminiſtered at bed-time. This plan will generally carry off the diſeaſe at once, if it has not been long accumulating in the ſyſtem, and will immediately prepare the way for the ſecond intention of cure, the uſe of tonic medicines. But when this is not the caſe, when the diſeaſe has been ſuffered to make a gradual and ſilent progreſs, without any complaint from the patient, and without any attempt or application for relief, it is neceſſary that the ſame means be employed, but with more vigour, and for a longer time. To the ipecacuan ſhould be added tartariſed antimony, which will ſerve to operate both as an emetic and cathartic, and, in fact with the purgatives, and diaphoretic mentioned before, ſhould be perſiſted in, till the excretions ſeem to be duly reſtored. With theſe medicines, the corrective plan is not inconſiſtent, indeed they form a conſiderable part of it: for if there is any other mode of correcting the poiſon ſo adminiſtered, and diffuſed over the conſtitution, as it is by fume, it moſt probably conſiſts in the operation of ſulphurets and alkalies, powers capable of altering it when out of the body. The preparations of ſulphur, and the mild alkalies, may be given internally, or they may be applied externally, in the warm bath; a remedy of itſelf moſt powerful, in promoting perſpiration, and which, therefore, ſhould be uſed either alone, or impregnated with the above correctives, as may ſeem expedient.

When the firſt intention of cure is fully anſwered, then may recourſe be had to the ſecond, which conſiſts in the adminiſtration of ſuch tonic medicines, as are appropriated to reſtore that ſtrength to the body, which it has loſt by the operation of the poiſon. On this topic I ſhall not enlarge: the means neceſſary to be employed for the reſtoration of the ſtrength of one poiſoned, are not peculiar to that ſtate; and they are ſo well known to conſiſt in bark, iron, &c. that I ſhall not repeat them.

I have known no inſtances in this country, of the mercurial fume producing its moſt terrible effect, immediate apparent death. Should this ever happen, bleeding, ſinapiſms, the warm bath, volatile alkali, electricity, and all the other means for reſtoring ſuſpended animation, ſhould be employed, in the order moſt likely to be beneficial, according to the exiſting circumſtances.

Perhaps the following order would be as proper as any. Open the jugular vein while the warm bath is preparing, and at the ſame time let the vapour of volatile alkali be applied to the noſe, and other ſenſible parts. Let the body be rubbed with ſalt, reſpiration imitated, and ſome air injected into the lungs, and glyſters of ſalt injected. If ſigns of life appear, vitriolated zinc ſhould be given as an emetic, and other ſtimulants, wine, &c. appropriate to the degree of vitality.

But it is, perhaps, of much more conſequence to ſhew how the diſeaſe may be prevented, than how it may be cured. — The firſt, and moſt important preventive, conſiſts in avoiding the fume altogether. This end may be accompliſhed by many mechanical means, by caution, and by vigilance. If, however, the workman by chance be expoſed to the mercurial fume, its effects may be accelerated or retarded, by attention to ſome moral, as well as prudential conſiderations.

I have before remarked, that intemperance or dirtineſs were great auxiliaries to the virulence of the poiſon, and that the infection was probably often occaſioned by the operation of theſe and other debilitating powers upon the body. As to intemperance, it is hardly neceſſary to obſerve, that every kind of labour is embittered by its indulgence, and that not one is aſſiſted by it. No prejudice can be more erroneous and abſurd, than that the uſe of fermented liquor is neceſſary to ſupport the labouring man under his toil. The great Dr. *Franklin*, who roſe from being a journeyman printer, to the higheſt ſtation of a free ſtate, was never uſed to drink any thing but water during his work; and when his fellow-labourers laughed at him for his temperance, and told him that it was impoſſible to work without drink, he ſhewed them by his own example, that it was not only poſſible, but that he who never drank ſtrong liquors, could work more than thoſe who did. In a familiar train of reaſoning, he demonſtrated to them that a penny-loaf muſt contain more nouriſhment than a quart of ale, as there was more grain in one than the other, and therefore would enable a man to go through more work. It would be well for mankind in general, and for the laborious part in particular, if theſe ſentiments were more general. A proper and moderate quantity of fermented liquor, is certainly uſeful to the labourer, and he deſerves the enjoyment: but exceſs renders him incapable of purſuing his employment, to ſo great advantage as he might; expoſes him more eſpecially to any dangers attendant upon it, as in the ſubject in queſtion, and renders him up an eaſy prey to infection and diſeaſe.

In this diſeaſe, dirtineſs is of more immediate conſequence than intemperance, as particles of mercury will be more eaſily retained, and by the habits of the individual will not be waſhed away. It cannot therefore be too ſtrongly inculcated to thoſe who are employed in gilding, or indeed any other work where metals are uſed, to adhere to the ſtricteſt rules of cleanlineſs. They ſhould not only moſt conſtantly waſh every part of the body expoſed to the air, whenever they leave work, but they ſhould alſo ſhift their cloaths when they return home in the evening, and thoſe garments they work in, ſhould be waſhed as frequently as poſſible.

I have reſted longer upon the diſeaſes afforded by the fumes of mercury, as I thought it might be uſeful for the information of thoſe who have no opportunities of ſeeing them; and uſeful to the health of a valuable order of men, to have them conſidered and diſcuſſed.

3. ANTIMONY.

WE are indebted to the alchemiſts for the diſcovery of the properties of this metal; and its advantages to mankind ſo well counterbalance its malignant qualities, that the diſcoverers muſt be ranked among the firſt benefactors of the medical art.*

Antimony, in its crude metallic ſtate, is inert,† from being joined to a very large portion of ſulphur; and all its preparations are proportionally inactive, as they contain this mineral. Thoſe which have no ſulphur in their compoſition, are very active, but they become leſs ſo by various other combinations, with nitre, and with alkalies. None of the preparations of antimony have the violent emetic effects of the pure oxide, the regulus, and the glaſs of antimony, that with oxygenated muriatic acid alone excepted. This latter compoſition, which is vulgarly called butter of antimony, is one of the moſt corroſive ſubſtances known, and the moſt virulent of all the productions from antimony. Applied to the ſkin, it even more ſpeedily deſtroys its texture, than nitrated mercury; and taken into the ſtomach, it inſtantly produces that conſtriction of the œſophagus and ſtomach, which always follows the other corroſives,* with exceſſive heat and thirſt, dreadful pain, vomiting and purging, ſometimes of blood, full quick pulſe, which terminate in cold ſweats, ceſſation of pain, hiccup, convulſions and death.

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* They certainly would have been exempted from the penalties of the Indian law mentioned by *Strabo*. "For the law was, that whoever invented any thing of a deadly or deſtructive nature, unleſs alſo he found out a remedy for it, ſhould himſelf be put to death; but if he found ſuch remedy, he ſhould be deemed worthy of honour and reward from government."—*Strabo* Geogr. lib. 25. c. 4.

† Baſilius Valentinus olim ad ſues pinguefaciendas ejus uſum commendavit.—*Hoffman* Obſ. Phyſico Chym. lib. iii. ob. 3.

If there can be any diſtinction made of the ſymptoms, from thoſe of nitrated mercury, it is, that the vomiting is more ſevere, and that the ſalivation is leſs conſtant: in other reſpects they will be very ſimilar.

On diſſection, the mouth, œſophagus, and ſtomach, and indeed every other part touched by the poiſon, will be found inflamed, corroded, and mortified.

I do not think that any tolerably diſtinctive marks of diſcrimination, can be given on the action

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[*] Afferam Illud Butyrum Antimonii per errorem exhibiti, ſtatim conſecutis faucium & ſtomachi couſtrictione, & ardore immani. —*Morgagni* Ep. lix. 374.

tion of this and the other corroſive poiſons. They will all corrode and inflame the parts they touch, and the appearances of theſe corroſions will much depend on the quantity of the poiſon taken into the ſtomach, and the form in which it is taken. They none of them can be miſtaken for the irregular jagged corroſions, which take place in the ſtomach after death, by the action of the gaſtric liquor, as they will be in ſome wiſe regular, and always ſurrounded by the appearances of inflammation.

Of the peculiar operation of the antimonials, we can ſay little more, than that their chief tendency is to excite vomiting, as that of the mercurials is to excite the ſalivary ſecretions. They, no doubt, have the power of diminiſhing or abſtracting from vitality, elſe, how can we account for their uſefulneſs in active inflammations? Certainly not from their being mere diaphoretics.

The operation of butter of antimony, when externally applied, is ſubject to the ſame reſtrictions, as nitrated mercury; what has been ſaid, therefore, on that head, will be equally applicable on this.

When butter of antimony is found in the ſtomach, it may be known from nitrated mercury, by not giving out red fumes when expoſed to heat:

and likewiſe by a copious precipitation of a white powder, when thrown into pure water.

The term of action of this, and all the other corroſives, is limited by the poſſible duration of inflammation, which has been known to terminate in eighteen hours, when the diſeaſe was in the ſtomach and bowels. From this period then, to three or four days, may exiſtence be prolonged, when the worſt effects cannot be prevented. It muſt be obſerved, however, that the means moſt likely to be purſued, on account of the feelings of the patient in this caſe, will be probably beneficial, and give a better chance for recovery than in many others. His thirſt will compel him to drink, and the fluid he takes into his ſtomach, will decompoſe the poiſon, deprive it of its corroſive qualities, and add to its emetic ones, and conſequently contribute to its diſcharge.

Hence the indications of cure are obvious.— For correcting the poiſon, we have only to pour a very large quantity of water into the ſtomach, and the very mean we take to correct it, will convert the poiſon itſelf, into its own evacuant, With the aqueous fluids, mild alkalies may be added, they will perhaps render the antimony leſs active in its operation, and at any rate they cannot be injurious. Sometimes the ſtomach, from being too ſtrongly excited, cannot diſcharge its contents; in this caſe a doſe of opium will be neceſſary, to reſtore the juſt ballance of action: but this remedy ſhould be adminiſtered with great caution, and only where there is abſolute neceſſity. It will be ſeldom neceſſary to adminiſter vitriolated zinc, as an additional and more ſpeedy emetic. The urgency of the ſymptoms may render its uſe, in ſome caſes, expedient, as where there is not ſufficient acid in the ſtomach to render the precipitated oxyd of antimony emetic; and then a glaſs of vinegar, or the alkali, would have the ſame effect. But the aqueous and mucilaginous liquors, thoſe ſimple means which are in every body's hand, and which may be always employed in large quantity without fear, are the remedies to be chiefly depended upon.

As ſoon as it is certain, that the poiſon is either corrected or diſcharged, if there are any ſymptoms of inflammation, they muſt be treated by the uſual antiphlogiſtic plan. In all the caſes where corroſive poiſons have been taken, the general treatment muſt be the ſame. The only difference that can be ſpecified, is in the chemical corrective to be uſed. All the reſt muſt be left to the good ſenſe of the practitioner, guided by the nature, and the ſtrength of the ſymptoms.

The glaſs of antimony has been ſuppoſed, by ſome authors, to produce ſpecifically poiſonous effects, independent of its ſtimulant action as an antimonial, which is indeed exceſſively violent.*

" Cognita nobis ſunt exempla aliquot, ubi vitrum antimonii in ſubſtantia propinatum non ſecus ac arſenicum, intra aliquot horas mortem intulit," ſays *Hoffman*.†

A ſcruple of vitrified antimony was given to a cat, by *Wepfer*.‡ The animal ſeemed to ſuffer much pain, but did not vomit, till an hour after it had been ſwallowed.

In another caſe, a cachectic woman, troubled with difficult breathing and a palpitation of the heart, took a few grains infuſed in white wine. She was attacked with enormous vomitings, and was found inſenſible. The vomitings did not ceaſe, till ſhe had taken plentifully of diluting liquors. When ſhe had a little recovered her ſtrength, ſhe complained of intolerable pain in her right foot, which in the end became ſphacelous, and was cut off. When every thing was apparently doing well, ſhe was ſeized on the fifteenth day after the amputation, with a ſuffocative cough, in which ſhe expired.

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* *Morgagni* de ſed. & cauſ. Morb. lix. 3. 6.

† Obſ. Phyſico—Chym. lib. iii. obſ. 16.

‡ Hiſt. Cicut. Aq. c. xx. p. 320.

On diſſection, the lungs adhered to the right ſide, and were much ſpotted: where they did not adhere, a quantity of water was found in the cheſt.*

If we are to judge from this caſe alone, there is certainly no reaſon for attributing to the vitrified antimony, any effects that are not common to the other oxides. The experiment on the cat, ſeems alſo to juſtify this opinion. But it was not only with this view that I adduced the caſe in queſtion. As there are ſeveral cauſes which may be aſſigned for the death of the patient, it will be uſeful to mention them, in order that we may be aware of the deceitfulneſs of the firſt appearances of ſome of the cauſes of death, and may be more cautious in our judgments and deciſions concerning them.

In the firſt place, death may have taken place from the water in the thorax; ſecondly, from the adheſion; thirdly, from the ſphacelus. That the four grains of vitrified antimony did not produce it, is probable, becauſe her difficulty of breathing does not ſeem to have been increaſed by it; and though its operation was violent, yet it was more likely to cauſe abſorption, than to induce dropſy. The ſphacelus of the leg, was full as likely to be produced by the general bad ſtate of health, as by debility from the action of the poiſon. That theſe conſequences did not follow the immediate action of the poiſon, is not aſſerted; indeed there ſeem to have been none of the immediate ſymptoms produced — no pain or inflammation. — Had this woman eaten any thing of the moſt ſimple kind, the ſame vomiting might have come on, with the ſame conſequences, and yet they would have been the effect not of the vomiting, but of her previous bad ſtate of health.

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* Hiſt. Cicut. Aq. p. 322.

The operation of the pure oxides of antimony, is that of the moſt active emetic kind, when they meet with a ſufficiency of acid to diſſolve, and of fluid in the ſtomach, to apply them to its internal ſurface. Such is their amazing activity, that they produce this operation from a quantity hardly to be calculated. In doſes therefore of a few grains, their ſtimulus may be ſo violent, as to produce inflammation of the ſtomach, with all its terrible conſequences, independent of any other operation.

The ſaline preparations of antimony are alſo very active, but not ſo much ſo as the pure oxides, they proving only gently emetic in the quantity of ſome grains, and a few of them, when united with nitre and abſorbent earths and alkalies, can be given in ſtill larger doſes, without danger. When given in too large quantity, they are all diſtinguiſhable by their violent emetic operation, and therefore are all, to a certain degree, dangerous. Tartar emetic excited inflammation in the ſtomach of a dog;[*] and there are many inſtances of its bad effects, when adminiſtered in too large a doſe, on the human body.

When externally applied, the oxides of antimony, and their ſaline compounds, are all capable of producing their appropriate effects: but to produce them, much larger quantities are required, than when taken immediately into the ſtomach. In ſome caſes related by Mr. *Sherwen*,[†] ten grains of tartar emetic were rubbed into the hands, and produced general irritation, and ſome ſickneſs. We may conclude from theſe experiments, that the antimonials are much milder in their operation when externally applied, than when taken internally, and that in this form they are not much to be dreaded.

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[*] Tartarum vero emeticum Vir alter experiens Jacobus Felix cum dedit Cani, & vomentem adhuc aperuiſſet, maximam ad Pylorum inflammationem, per aliquot pollicum Spatium vidit. — *Morgagni* de ſed & cauſ. lix. 374.

[†] Mem. London Med. Soc. vol. ii.

The preparations of antimony in general, may be diſcriminated from thoſe of mercury by their taſte; but as all of them will be materially altered in this reſpect by the contents of the ſtomach, this criterion is not to be depended upon alone. By heat the oxides of mercury ſoon fly off in the form of vapour; this is not the caſe with the oxides of antimony, which are little altered by very high degrees of heat. The oxides of mercury may alſo be reſtored to their metallic form, by chemical proceſs.*

The term of action of the antimonial oxides, will be much the ſame as that of the other ſubſtances which act by ſtimulating the ſtomach too violently, and thereby exciting inflammation.

The cure muſt be undertaken with the view of diſcharging the offending ſubſtance, and ſheathing the ſtomach and inteſtines from its virulence. For theſe purpoſes the diluent plan muſt be reſorted to in its fulleſt extent. While the preparation of antimony remains, it is uſeleſs to give any other medicines than thoſe which will aſſiſt its diſcharge. Thus, if the ſtomach be too ſtrongly excited, an opiate muſt be given with the aqueous and mucilaginous liquors. When the active and immediate operation is overcome, its conſequences ſhould be prevented, as much as poſſible, by avoiding any ſtimulating medicines, and perſevering in thoſe moderate remedies which heal and guard againſt inflammations, as broths, gentle evacuations, &c. &c.

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* Galls precipitate mercury from ſolution of a yellowiſh colour—Antimony of a bluiſh-grey.

I ſhall conclude with *Newman*'s abridged account of the effects of the various preparations of antimony, from *Hoffman*. — He obſerves:

" 1. That crude antimony, on account of the regulus being corrected by the ſulphur, is not only ſafe, but in many reſpects a medicine of great ſervice, both for man and other animals.—2. That by ſimple fuſion, it acquires a degree of malignity; but a far greater, if melted with half its weight of nitre, which conſumes nearly all the nitre, and leaves the regulus bare. — 3. That antimony, or its regulus, mixed with common ſalt, calcined over a gentle fire for ſeveral hours, and kept continually ſtirring, and afterwards edulcorated with water, yields an aſh-coloured calx, which is ſo fixed as to bear a melting heat, and proves a mild and ſafe diaphoretic. — 4. That antimony, by calcination with a gentle heat in an earthen veſſel, changes into a calx which melts difficultly, and has no malignity. — 5. That if this calx be melted with a ſtrong fire into glaſs, it becomes ſo active, that a few grains ſhall occaſion violent vomitings, purgings,

ings, or even mortal convulſions and death. — 8. That equal parts of nitre and antimony, melted together, yield a virulent maſs; but one part of antimony, with two or three of nitre, an uſeful diaphoretic. — 9. The ſame happens with the regulus. — 10. That on melting the diaphoretic calcis with fat, or charcoal, or nitre, the virulent regulus is revived.*

The following is Dr. *Black*'s liſt of the preparations of antimony.

1. By triture. — Prepared antimony.

2. By the aid of fire and air.

   Flowers of antimony.
   Glaſs of antimony.

3. By the power of alkaline ſalt.

   The mild hepar of antimony; or,
   Medicinal regulus of antimony.
   Kermes mineral.
   Precipitated ſulphur of antimony.

4. By the power of nitre.

   Mild antimonial crocus.
   Nitrated calx of antimony.

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* *Newman's* Chemiſtry, vol. i. p. 99.

5. By the power of acids.

Vitriolated antimony.
Antimonial cauſtic, or butter of antimony, or
Muriated antimony.
Powder of algaroth.
Bezoardic mineral.
Tartariſed antimony.

This metal, according to the different modes by which it is ſeparated from ſulphur, is called, ſimple regulus of antimony, martial regulus, &c. &c. From it are prepared,

1. The ſnow of antimony, by the aſſiſtance of air and fire.

2. With nitre,

Ceruſſe of antimony.

The cinnabar of antimony, and the tincture, ſcarcely retain any particles of this mineral.

4. SILVER and GOLD.

SILVER, when taken into the bodies of animals in its pure metallic ſtate, is entirely harmleſs; but when joined with the nitric acid, it forms a moſt corroſive compound, The ſmalleſt portion of nitrated ſilver, applied to the ſkin, marks it with a blackiſh ſpot, and conſumes it, till its powers are exhauſted.

The oxides of ſilver, as far as I know, are not injurious to the health of animals; and few of the acids or alkalies act upon the metal forcibly. Indeed of the acids, the nitric alone acts ſo thoroughly upon it, as to render the compound an object, of commerce or of medicine.

The muriatic, and the nitro-muriatic acids beſides, form corroſive compounds; as does the ſulphuric acid in a boiling ſtate; but theſe preparations are only to be found in the elaboratories of chemiſts. — The alkalies do not affect ſilver.

Of all the compounds of ſilver with acids therefore, that with the nitric acid is the moſt to be dreaded, on account of the frequency of its uſe in medicine, and conſequently the eaſe with which it is procured.

Taken into the ſtomach, nitrated ſilver produces all the conſequences which follow the improper uſe of nitrated mercury, or of any other ſubſtance capable of corroding the texture of the part. Exceſſive pain, ſickneſs, thirſt, with vomiting and purging of blood: theſe, if the quantity ſwallowed were large, muſt proceed to mortification and death.*

On diſſection, the appearances will be the ſame as if nitrated mercury had been ſwallowed; corroſions ſurrounded by the appearance of inflammation,

The external application of nitrated ſilver is circumſcribed exactly within the ſame limits as that of the other corroſives. The injury they do, muſt depend upon the part to which they are applied. The application can be ſeldom ſo extenſive, as to cauſe immediate danger of life, without ſufficient warning being given previouſly to the patient; and yet may they be applied in ſuch a manner as to render its continuance but of little value.

If

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* Nitrate of ſilver, taken for an obſtruction of the liver for ſeveral months, changed the ſkin gradually, nearly black. The colour laſted ſeveral years, but is now wearing off. — La Medicine eclairee par *M. de Foureroy.*

If nitrated ſilver be found in the ſtomach, it may always be diſcriminated by mixture with a ſolution of common ſalt, which precipitates it entirely, and the precipitation, on expoſure to light, becomes blackiſh. Galls precipitate ſilver from ſolution in reddiſh ſtriæ, which afterwards appear like burnt coffee.[*]

The quantity of nitrated ſiver that may occaſion death, will vary according to the ſtate of the ſtomach at the time of its being taken, both with reſpect to its health at that particular time, and what it may accidentally contain. If it contain a conſiderable quantity of mucus or fluid, it is leſs likely to be injured.[†] But if the ſenſibility of the body, and its ſuſceptibility of inflammation, be greater than uſual, much leſs nitrated ſilver than is comonly hurtful, may produce the moſt fatal effects. Some authors[‡] recommend it, in doſes of five grains, but I truſt their recommendation will never be followed by any perſons of common ſenſe or prudence. Even in ſmaller doſes than theſe, I believe it is capable of being injurious, and even fatal; indeed is a medicine ſo much to be dreaded, that its *internal* uſe ſhould be abſtained from altogether. We cannot be certain that the ſtomach may not be met with in ſome irritable habit, in ſuch a ſtate as to be inflamed by the ſmalleſt quantity of it, but we well know that other medicines anſwering every intention for which it may be adminiſtered, can be given without riſque.

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[*] *Fourcroy* Elements of Chemiſtry, Note Tranſ. vol ii. p. 532.

[†] Ex argento, chryſtallis lunæ præſentiſſimæ corroſivitatis, nonnulli pilularum forma ad hydropicas aquas utuntur educendas, quod etiam faciunt, si magna copia liquidi quo ejus corrosiva acrimonia diluatur, deſuper hauriatur, cauto tamen hic opus eſt, enim notavimus ab hujuſmodi pilulis repetita dosi datis, cruentas ſedes cum ingenti virium lapſu ſucceſſiſſe. — *Hoffman* de inſec. Med. tom. vi. p. 313.

[‡] *Partridge*'s Treaſury of Phyſic, p. 21, originally written in Latin by *Hadrianus a Mynſicht*, a book in vogue during the laſt century. We may form an accurate judgment of its merits from the firſt medicine in it, the Unicornu minerale, "a glorious, myſterious, univerſal medicine, and "ſuch a treaſure, that is able to cure all diſeaſes, by what name ſoever "they are called in all and every creature."

The time in which the corroſive poiſons may operate, is nearly the ſame in all. It is limited by the ſhorteſt poſſible duration of active inflammation, which has terminated in eighteen hours.

The cure of all the corroſive poiſons muſt be undertaken with nearly the ſame intentions.—The ſtomach and inteſtines ſhould be ſheathed by very copious draughts of oil, milk, mucilage, or even water. With the alkalies, common ſalt may be adminiſtered to correct, and vitriolated zinc to diſcharge the poiſon. In the caſe of nitrated ſilver, common ſalt being always at hand, is a corrective which ſhould be very copiouſly uſed, and indeed none other is requiſite.—Of the ſtate ſucceeding the expulſion or correction of the poiſon, I have ſpoken before, under the head of nitrated mercury.

Beſides this corroſive preparation, ſilver furniſhes another, remarkable for its fulminating power. An oxide of ſilver, precipitated from its ſolution in nitric acid by lime water, and expoſed for three days to the air and light, in the heat of 120 deg. burſts into a tremendous exploſion, even in the ſmall quantity of a grain.* Whether this dreadful preparation can be conveyed into the ſtomach, and whether it will act there as a corroſive poiſon, are problems yet to be proved.—Its ſimilarity to fulminating gold, has induced me to place it here.

GOLD only becomes active by ſolution in the nitro-muriatic acid, and by precipitation from that ſolution, by means of volatile alkali.

Of the ſolution of gold in the nitro-muriatic acid, the phœnomena are well known, and it is an eſtabliſhed fact that its effects are corroſive. Probably they are as much ſo as thoſe of nitrated ſilver; we have, however, no other grounds to proceed upon, than the analogy they ſeem to bear to each other.

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* Prenez de l'argent de coupelle, diſſolvez le dans l'acide nitrique, Precipitez l'argent de cette diſſolution par l'eau de chaux; decantez & expoſez le Precipite pendant trois jours a l'air.

La poudre a canon, l'or fulminant meme ne peuvent pas etre compares a ce produit nouveau.

Une goutte d'eau tombe de haut ſur l'argent fulminant, l'a fait fulminer.——Journal de Phyſique, 1788, p. 474.

Of the fulminating gold our knowledge is rather more preciſe. *Hoffman*, *Rolfincius*, *Plenck*, and *Gmelin*, have all recorded inſtances in which, in the quantity of ſix or eight grains, according to the ſtate of the patient, it produced very alarming, and even fatal conſequences, when taken internally.

An infant was ſeized with tormina and ſpaſms, and ſoon after died, from ſix grains.

An hypochondriac had anxiety, ſpaſms, tormina, fainting, and cold ſweats, from four grains.

An irritable ſcorbutic woman was purged twenty times, with tormina, fainting, &c. from two grains.*

From theſe, and many other inſtances, it appears to be a very acrid ſtimulant, which may prove fatal in very ſmall quantity, and which muſt be remedied by thoſe means employed in caſes of corroſive poiſons.

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* *Hoffman*, tom. vi. p. 312.

Gold in ſolution may be diſcriminated by ſtaining tin of a purple colour.

5. COPPER.

IN its pure metallic ſtate, copper is harmleſs. But it is ſo eaſily combined with all the acids and neutral ſalts, with rancid oils, and with the alkalies, that it may be readily taken into the ſtomach; and it can be taken in no ſhape, without the moſt imminent danger. In food, it may be combined by the proceſs by which our aliment is prepared for the table. With wines, and even water, it will be mixed, if they contain but the ſmalleſt portion of acid.* And in fact, we can never be entirely ſecure from the danger of this poiſon, till every utenſil containing copper is baniſhed from the kitchen, and till our cooks are forbidden, under the ſevereſt penalties, from improving the colour of conſerves, at the riſque of health, or even of life.

Againſt its malicious uſe, we can only employ our knowledge to detect, and our ſkill to heal its bad effects.—In the one caſe, to drag the aſſaſſin before the tribunal of the laws, and in the other, to pour balm into the wounds of the ſufferer.

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* On the different modes of its combination, and the facility with which it may be mixed with our aliments, ſee the very uſeful treatiſes of the learned Drs. *Falconer* and *Fothergill*, of Bath.

The ſymptoms from copper are various, according to the preparation taken, and the ſituation of the patient at the time.—If nitrated copper be ſwallowed in any quantity, its corroſive qualities will produce all the bad effects of that claſs of poiſons, beſides the other ſymptoms that are appropriate to copper.—From the other corroſives, it will be diſcriminable on this latter account, and from the other preparations of copper, on account of its corroſive qualities.

When the vitriolated, acetated, or ammoniated copper are ſwallowed in any quantity, inſtantaneous vomiting generally takes place, eſpecially from the vitriolated and ammoniated.—If the poiſon be not diſcharged by the vomiting; eruptions of the ſkin, exceſſive thirſt, ſometimes violent purging, at others coſtiveneſs,* with the deſire, but not the power of diſcharging any thing, follow, with ſhifting pains of the ſtomach, belly, and ſides, which are ſevere and griping from the firſt, but ſeldom encreaſe to that degree of anguiſh as in caſes of arſenic and corroſive ſublimate. The tongue is dry and white, the ſkin parched, the eyes red and wild, the pulſe beats quick and hard, and reſpiration is performed with anxiety and diſtreſs. If the patient be not relieved from theſe ſymptoms, they proceed to cold ſweats, delirium, convulſions, great ſwelling of the body, and death. During the whole courſe of the vomitings, which are very ſevere, the taſte of copper will be perceptible to the patient, and the matter rejected both by vomiting and ſtool, will moſt frequently be tinged of a green colour. Theſe are the general ſymptoms, which I ſhall beg leave to illuſtrate by ſome examples. Variations will occur in all caſes, from a thouſand unforeſeen or unknown circumſtances, but the outline is ſufficiently marked, not to be miſtaken.

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* Plenck de Venenis, p. 245.

" Three ſeamen of the Cyclops frigate, having " eat ſome victuals prepared in a foul copper, " complained ſoon after of violent gripes, giddi-" neſs, and vomiting, and they had a few looſe " ſtools. There was intenſe heat, the pulſe full, " quick, and hard, a tremor of the hands and " tongue, and wildneſs of the eyes. The looſe-" neſs was ſoon ſucceeded by obſtinate coſtiveneſs, " tenſion of the abdomen, difficult breathing, and " loſs of deglutition. In the night, towards the " morning, there came on inſenſibility, with an " increaſe of all the ſymptoms except the heat. " The body was violently convulſed, with cold " clammy ſweats, and coldneſs of the extremities. " The abdomen ſubſided a ſhort time before they " died, and a ſmall quantity of greeniſh matter, "mixed with phlegm, iſſued from two of their "mouths. Thirty-three other men were put upon "the ſick liſt with ſimilar ſymptoms in a leſs degree, and ſome of them continued on the liſt for "five or ſix weeks before they perfectly recovered."*

"A delicate young lady, while her hair was being dreſſed, amuſed herſelf with eating ſamphire pickle: this was on the 25th of Auguſt. Thirſt came on ſoon after ſhe had eaten the pickle, and the ſame evening ſhe complained of pain in her ſtomach, and perceived a raſh upon her hands and breaſt. She paſſed ſeveral days without a ſtool, and felt an univerſal ſoreneſs with ſhifting pains. On the 30th of Auguſt ſhe begun to vomit. The retchings were inceſſant on the 31ſt, with a diſcharge of ſamphire, &c. of a green colour. Her ſtomach was prodigiouſly diſtended. She died the 3d of September, nine days after eating the pickle impregnated with copper.

On diſſection, the internal coat of the ſtomach was found inflamed and gangrenous, particularly about the pylorus, and this appearance extended itſelf ſome way down the duodenum.†

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* *Gordon* in *Blane's* Obſ. on the diſeaſes of ſeamen, p. 298.

† *Percival* in Med. Tranſactions, vol. iii. p. 80.

The moſt dreadful convulſions he ever ſaw, Dr. *Percival* ſays were produced by two drachms of vitriolated copper.[*]

A boy who ſwallowed a halfpenny, was ſo ſick the ſucceeding day, that he could retain nothing upon his ſtomach. He vomited a large quantity of a green-coloured fluid, which had the ſmell of verdegris. In the evening a glyſter was injected, the halfpenny came away, and the boy recovered.[†]

Newman knew a perſon, who having accidentally ſwallowed a braſs ſleeve-button, was ſeized with violent ſymptoms, and died in miſery, no medicines giving relief.[‡]

Neumann likewiſe mentions, that he has ſeen very ſevere vomitings, with gripes and convulſions, from the application of the unguentum ægyptiacum to the mouths of children. I have known the ſame inconveniencies ariſe from the uſe of a cupreous ointment for the cure of aphthæ, and in one caſe the life of the child was ſaved with difficulty; though from the quantity of ointment applied to the mouth, the portion of copper taken into the ſtomach muſt have been very ſmall.

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[*] *Percival* in Med. Tranſactions, vol. iii. p. 88.

[†] Ibid. p. 87.

[‡] *Neumann*'s Chemiſtry, vol. i. p. 98.

On diſſection, the ſtomach and inteſtines are always found inflamed and mortified, from the internal uſe of copper. By the nitrate of copper, they may be corroded alſo, but this is the only one of its preparations that will have this effect.

Copper, applied in ſubſtance or ſolution externally, may certainly affect health, but can ſeldom be applied ſo univerſally or continually, as to deſtroy life in any ſhort time. When rubbed by the fingers, copper emits a fœtid odour, which adheres to the ſkin for ſome time. Dr. *Falconer* quotes a caſe from the Medical Muſeum, in which a perſon loſt the uſe of his hands by cleaning braſs wire.*

A girl who was under my care, for a very obſtinate eruption of the hands, arms, and neck, with griping pains of the ſtomach and bowels, and coſtiveneſs, could give no other account of her diſeaſe, than that ſhe was the ſervant of a perſon who waſhed ſilk ſtockings, and was employed in that work herſelf. She did not know the compoſition of the waſh, as it was kept ſecret, but from her deſcription of its blueneſs and ſmell, I have no doubt it contained copper. I adviſed her to leave her employment, and ſhe ſoon afterwards got well.

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* On Copper, p. 50.

In fumes, the external application of copper is not ſo deleterious as that of mercury, and the other poiſonous minerals. I have rarely ſeen any of the perſons employed in melting braſs, or working in copper, great numbers of whom live in Birmingham, affected to any conſiderable degree, In ſome few caſes however, diſeaſes occur, probably from inattention, intemperance, or want of cleanlineſs. Bad taſte, pain of the bowels, irregularity of their motions, nauſea, and ſlight tremors, are the worſt ſymptoms I have met with in the workmen of braſs-founderies, palſies never, but in ſome of them a tendency to phthiſical complaints.*

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* The caſe of Mr. Butler, related in the 50th and 54th vols. of the Phil. Tranſ. is very remarkable, and demonſtrates that conſtitutions ſo irritable, may be found occaſionally, as to be affected by the external uſe of copper in very ſmall quantities; and alſo of many other metals, which are innoxious to the bulk of mankind.

" The handling of verdegris, vitriol, copper, or iron, gave him anxiety, tremor, faintings, and many other uneaſy ſymptoms."

In the 54th voi. his caſe is very minutely deſcribed; when he was affected with the following ſymptoms from touching with the middle finger of his right hand, a compoſition of blue vitriol, alum, lime, and alabaſter. Three hours afterwards, he found pain in his arms, he was ſick, and felt a trembling over his whole body, with faintneſs. Before he perfectly recovered, he had many paroxyſms ſimilar to the one with which he was firſt attacked: and it is moſt probable that theſe attacks aroſe from the metals, as they were a certain conſequence of their being handled.

" One day having got home a box of ceruſſe, he took out ſome lumps

Ramazzini ſays, that the ſubtle atoms which exhale from copper, change the hair of the workmen green, and when they enter the lungs, raiſe a dry cough, &c.* *Galen* aſcribes a difficulty of breathing to the workmen who carried water from a cave in Cyprus, impregnated with copper.†

On the whole, from the indeciſive manner in which the danger of the external uſe of copper is ſpoken of by ſome authors,‡ and the great uſe that has been made of it in all ages, we may conclude, that it has not been very generally found deleterious in this mode of application, though when given internally, it is always ſo virulent a poiſon.

There is little difference in the degrees of virulence of the preparations of copper; that with the nitrous acid, and, perhaps, with the oxygenated muriatic

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to examine the quality. In a few hours afterwards, he was taken with anxiety, palpitation of the heart, and a ſenſe of trembling and a weakneſs of the whole body."

* De Morb. Artif. c. vi.

† Aeris odor viſus eſt ſuffocans & toleratu difficilis, chalcitin æruginemque redolens.—De ſimp. Med fac. lib. ix. p. 71.

‡ In aſthma, "death is protracted to labourers, whoſe lungs are heated and dilated, in ſome employments, ſuch as lime copper-works."—*Aretæus* Morb. diut. lib. i. p. 40.

muriaric acid, excepted.——Dr. *Falconer* places them in the following order.*

1. Nitrated copper.
2. Muriated copper.
3. Acetated copper.
4. Ammoniated copper.
5. Sulphurated copper.

The green ruſt which is found on antient metals is alſo very active. With rancid oils, copper probably becomes ammoniated. With neutral ſalts its combinations are milder than any of thoſe above enumerated. Few of the preparations of copper can be given in larger quantity than four or five grains without danger. In the caſes before related, the portions acting muſt have been very ſmall. Much of the halfpenny, and the whole of the ſleeve-button, was not diſſolved, though ſuch violent effects were produced.

Sulphate of copper is ſometimes given as an emetic in doſes of a few grains. and is generally diſcharged by its own operation; ſhould it chance ever to remain behind, the quantity of ten or twelve grains is capable of deſtroying life.†

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* On Copper, p. 36.

† Great anxiety from ſix grains.—*Hoffman* Med. Rat. Syſ. tom. ii. p. 290.

Ammoniated copper produces ſickneſs in the quantity of half a grain or a grain; from eight or ten therefore, inflammation would moſt likely follow. It is impoſſible then, that too great caution can be diſplayed in guarding againſt this poiſon, which, from the quantity in which it acts, lies particularly open to the deſigns of malice, and which by art or by negligence, may be ſo eaſily introduced into our nouriſhment, and taint the ſources of life, at the moment that we are endeavouring to preſerve it.

When copper is found in the ſtomach, there will be no difficulty in diſcriminating it from every other poiſon, under whatever form it may lurk. Volatile alkali converts all the ſolutions of it, to a beautiful blue. *Bergman*'s phlogiſticated alkali, precipitates it from ſolution of a darkiſh red. Galls precipitate it of a green, afterwards turning red. It is likewiſe precipitated from ſolution in its metallic form, on poliſhed iron.

Copper ſeldom deſtroys life in leſs than two or three days. In the caſe of the ſamphire pickle, nine days elapſed before its operation terminated. The progreſs here was probably occaſioned by the gradual evolution of the copper by the proceſs of digeſtion. In the firſt inſtance, there was a ſufficiency to excite uneaſineſs, and to produce coſtiveneſs:

neſs: life was gradually conſumed by the remainder being detained in the body, and not acting at once, but coming forward by morſels. Had the young lady taken as much acetated copper in a liquid form, as was contained in the ſamphire, ſhe probably would have eſcaped. The worſt ſymptoms appearing at once, would have given the alarm, whereas from the mode in which it was taken, life was undermined, before danger was apprehended.

Why copper ſhould take a longer time to abſtract the vital principle, than the virulent corroſive poiſons, I cannot explain. That the general action of all the virulent poiſons, is to a certain degree alike, I do not doubt; but what are thoſe circumſtances which allow life to continue forty-eight hours, or three days, in caſes of copper, whereas from arſenic people die in four or five? The acceſſion of the ſymptoms in the firſt caſe, is as quick as in the latter, for copper, though taken into the body in its metallic form, begins to act the moment it meets with a ſolvent.

The diſtinguiſhing ſymptoms of copper are the inſtantaneous vomiting, and the green colour and cupreous ſmell of the matters diſcharged. The taſte of every thing that contains this metal is peculiarly nauſeous, and is well known by the name of a coppery taſte. This laſt ſymptom is not abſolutely a criterion, as ſome of the mercurials afford a taſte which is very ſimilar to that of copper; when, however, it is conjoined with thoſe other ſymptoms which never ſucceed in conſequence of mercury, it may be depended upon. Copper is ſaid to produce an inability to open the fingers, but not the ſame flabbineſs of the muſcles as lead.* Moſt of the other ſymptoms are common to the acrid poiſons. The intenſe heat, fever, and griping pains, are perhaps aggravated in the virulent and corroſive poiſons, and they are attended with a burning ſenſation in the throat, which does not follow the ſwallowing of copper. The duration of the ſymptoms will alſo diſtinguiſh it from moſt of theſe poiſons.

The cure of thoſe poiſoned by copper, muſt be undertaken with the ſame intentions, and in general purſued by the ſame means, as in other caſes of poiſon. Our hopes of correcting indeed, cannot be very great, as all the ſolutions of copper are deleterious; yet we may render them leſs noxious by combination, and thus partly fulfil a very material indication of cure.—When the poiſon has been taken but a ſhort time, the firſt attempt ſhould be to diſcharge it, by pouring large quantities of aqueous and mucilaginous liquors into the ſtomach, and by adminiſtering at the ſame time a good doſe of vitriolated zinc. — When the poiſon has been taken a conſiderable time, an active emetic may often be of ſervice, as in the caſe of the young lady related before, who vomited up ſome portions of ſamphire ſeven or eight days after it had been eaten: but as it muſt be imagined long before this time to have commenced its attack on the conſtitution, other efforts muſt be alſo made to obviate or heal its bad effects. Mild alkalies, hepar ſulphuris, or flowers of ſulphur, ſhould then be given; and they may be applied without any active evacuants, when we are certain that the poiſon is for the moſt part diſcharged. If the poiſon either were taken in its metallic ſtate, or be ſuppoſed to have reached the inteſtines, by no more of it being diſcharged by vomiting, recourſe ſhould be had to briſk cathartics, as ſcammony or jallap, which may be given with good effect, along with caſtor oil, or even common oil. Acids, in all caſes, muſt be carefully avoided. Small portions of copper taken at intervals in food, may accumulate in the body, and I believe that this mode of taking it, is a much more frequent cauſe of diſeaſe, than is generally known or imagined. If this ſhould be known to happen, the ſtomach muſt be cleared by repeated vomits of ipecacuan, and the body kept open by flowers of ſulphur. The demulcent and diluent plan may be purſued here with advantage; and the patient may uſe the ſulphurated bath. Alum is warmly recommended by Dr. *Percival*, as a tonic, when the poiſon of lead has been taken into the body. In caſes of copper, I think it may be alſo uſeful, when the immediate operation of the poiſon is paſt, and the patient labours under conſiderable debility. — The ſame means that are here recommended for the ſlow reception and gradual accumulation of copper in the body, will be applicable to its external abſorption.

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* *Falconer* in Mem. London Med. Soc. vol. ii. p. 224.—Conſult likewiſe the ſeaſonable cautions of the learned Dr. *Fothergill* of Bath, concerning the miſchiefs ariſing from copper and lead in culinary veſſels, &c.

Fortunately the difficulty of keeping nitrated copper conſpires with its ſmell and taſte, to prevent its common uſe; ſhould it however be employed with a criminal or injudicious intention, the cure muſt be undertaken by the ſame means, as for the other preparatious of copper.

6. LEAD.

THIS poiſon is more likely to find its way into the ſtomach without being perceived, than any of thoſe I have yet mentioned. The ſweet aſtringent taſte of acetate of lead, commonly called ſugar of lead, may be readily miſtaken for a harmleſs compoſition; and the taſteleſs, or ſub-dulcid oxides of lead, may be ſwallowed without the ſmalleſt ſuſpicion, eſpecially if their colours be not obſerved.

Lead, in its metallic ſtate, like all the other metals, is probably inert: but it is ſo eaſily acted upon by the weakeſt acids and alkalies, that it cannot be taken even in this form without the moſt imminent danger.

Mrs. *P*—, who had long laboured under phthiſical complaints, with pain of the ſtomach, and eructations, which, ſhe fancied, proceeded from the riſing of the lights, (lungs,) had taken for three days ſucceſſively, *to keep down the lights*, 240 common ſized ſhot. Her huſband obſerved the ſhot in her ſtools, the third day after ſhe began to take them; ſhortly after, the pain of the ſtomach was aggravated to a violent degree, the left eye became diſtorted, the left arm and leg paralytic, and ſhe died in about a month.

I was once conſulted by a woman, whether ſhe ſhould not give her infant, who had been poiſoned by gin, and whoſe ſtomach was conſequently ſo weak as to reject every thing, ſhot to cure this diſeaſe, which ſhe called the riſing of the lights.

From theſe caſes it would appear, that this fatal prejudice is more deeply rooted, than at firſt ſight could be imagined; and I have related them, in order that its conſequences may be more efficaciouſly counteracted.

Lead has far the precedence of all the poiſonous minerals with reſpect to antiquity. *Nicander*, a poet and phyſician probably about the the time of *Ptolemy Philadelphus*,* of all the metals mentions only ceruſſe and litharge as poiſons. To the age of *Celſus*, orpiment and copper alone of the metallic ſubſtances, were added to the liſt of the preparations of lead, which he ſays purge, corrode, and conſume the body: thoſe deadly properties are acknowledged by *Pliny*; and mankind are now ſo well aware that health may be undermined, or even life deſtroyed, by their reception into the body, dy, that utenſils of lead are generally proſcribed by domeſtic œconomy.*

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* *Le Clerc* Hiſt. de la Medicine, p. 330. 4to.

The effects of lead taken into the ſtomach, either in the form of oxide, or diſſolved in acid, is much the ſame. In the latter caſe, the ſymptoms accede more quickly, as the activity of the oxide depends upon its meeting with an acid in the ſtomach. In both caſes, when the quantity taken is ſufficient to produce an apparent operation, if vomiting does not immediately follow, dryneſs of the throat, with a ſenſe† of conſtriction and weight in the ſtomach and inteſtines, firſt comes on, with ſlight and ſhifting pain. The belly then becomes hard and conſtricted to the touch, all the excretions are totally ſtopped, or partially impeded. The pulſe is quick and hard, the tongue white, and the pains of the bowels are ſo intolerable, as to bend the body forward, and are accompanied with general tremors.

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* Of ſo great and extenſive uſe is this metal in the arts, that it is not very eaſy to avoid it altogether. In enters into all ſolders, it forms the glaze of earthen-ware, particularly of the coarſer ſort. Some waters contain ſo much acid, as to diſſolve the leaden cylinder which is frequently employed in pumps; of this we have a very ſingular and fatal inſtance, in a letter from Dr. *Wall* to Sir G. *Baker*.

† Spuma-argenti pota, ſtomachi, ventris & inteſtinorum gravitatem inducit, cum torminibus, quandoque etiam inteſtina fauciat gravitate, & urinas ſupprimit.

Et qui ramenta plumbi aut loturam hauſerunt, ſimilia ſymptomata habent.—*Paul. Æginetæ*, lib. v. c. 60.

If theſe pains are not quickly alleviated, reſpiration is affected, anxiety comes on, with convulſions and cold ſweats, and death ſoon terminates the torments of the patient. The tremors, which accede very early, do not degenerate into abſolute palſy, till near the cloſe of the diſeaſe. This is the moſt general courſe of the ſymptoms when a very large doſe of the oxides, or acetate of lead, produces an immediate operation. In this caſe the ſymptoms accede in eight or ten hours in their moſt violent degree, and terminate in three or four days.

In *Sproegel's* experiments, the effects were more quick upon dogs:[*] and a number of ducks and geeſe were killed during a night,[†] by drinking water impregnated with lead from paint.

A hearty man ſwallowed by miſtake near ℥ß of ſugar of lead in ointment; vomiting inſtantly ſucceeded, with violent pain of the ſtomach.

On diſſection, the ſtomach and ſmall inteſtines are found inflamed, but in a ſlight degree; ſometimes the bowels are conſtricted. The inflammation is never ſo marked as from the foregoing poiſons,

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[*] Diſſ. inaug. circa varia venena Exp.

[†] *Percival* on Lead, p. 7.

ſons, in caſes of lead, and corroſions cannot take place from it.

But the immediate action of the poiſon of lead is not the moſt dreadful: we ſeldom hear of caſes, in which death ſo ſpeedily occurs from it, as three or four days, the patient being more frequently reſerved for the protracted ſuffering of a week or fortnight, even when the doſe was very large.

" A man for the cure of the gout was adviſed by an empiric to uſe an oxide of lead, which he did in ſuch quantity, as to take half a pound in the courſe of fifteen days. On the twelfth day after he began the uſe of the lead, he was attacked by dyſentery and fever, with ſuch excruciating pains of the ſtomach and bowels, as not to be able to bear the ſlighteſt preſſure. Every thing he took was converted into a ſlimy fluid, with a ſaturnine nidor, and was quickly returned. The pains continued for twenty days after the dyſentery, and during that time he diſcharged nothing by ſtool without a glyſter. His recovery was preceded by a very obſtinate jaundice."*

" A woman of tender conſtitution, with tendency to phthiſical complaints, took five grains of acetated lead, thrice every day. The ſixth day after ſhe had firſt taken this medicine, all expectoration was ſuppreſſed. On the tenth, ſhe felt ſlight anxiety, and weight in the abdomen, and the belly was bound. On the ſixteenth, the pains in her belly were moſt grievous." — Zonamque ferream, hypochondria acerrime conſtringentem, æmulantes. On the nineteenth, having received no relief from emetics, her breathing became laborious, with great anxiety and debility, ſevere pain, the motion of the arms impeded, the fauces and tongue dry to rigidity, pulſe quick, weak, and hard. A glyſter with ol. lini ℥iv. diacodium ℥i. was ordered every two hours, A pint of whey, with ℥i. of manna, and ʒi. of diacodium, for common drink. During the night ſhe had ſix ſtools. On the twentieth ſhe began to mend, and on the thirtieth could move her hand. She was entirely free from the ſaturnine affection, ten days thereafter, but died conſumptive during the year."*

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* Fernelii Univerſa Medicina, vol. ii. c. 7. p. 230.

In another caſe related by the ſame author, a man who took twelve grains of acetated lead every morning for a gonorrhœa, was not affected till the eighteenth day with the pains, but the palſy here was more obſtinate. It may be obſerved, that in the firſt inſtance fifteen grains of acetated lead were taken every day, and the apparent operation commenced on the tenth day. In the latter, twelve grains began to operate on the eighteenth day.— The difference in the protracted operation from the immediate, is in the very great weakneſs of the alimentary canal, and the almoſt conſtant acceſſion of palſy, in the former caſe. The violent pain is the ſame in both, and they both attack life much in the ſame way. But when the ſpace of ſeveral days has paſſed from the firſt taking of the poiſon, the tone of the ſtomach and bowels is gradually abſtracted; whereas in the other caſe it is ſuddenly attacked; and when the worſt operation commences, nauſea, vomiting, eructations, &c. are particularly diſtreſſing.

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* Sandifort Theſaur. vol. ii. p. 56.

The ſaturnine diſeaſe is longer in appearing, according to the quantity of lead uſed, and the power of the body to reſiſt it. In the ſmalleſt quantities it produces the diſeaſe when taken for a ſufficient time; and in proportion to the length of time before the apparent operation commences, the diſeaſe perhaps is more obſtinate, on account of the vitality of the body being more copiouſly abſtracted. But I ſhall refer for all farther information on this ſubject, to the works of a very learned phyſician* of our own country, who has carefully inveſtigated, and accurately deſcribed the colic produced by lead.†

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* Sir *George Baker's* Diſſ. in firſt and ſubſequent volumes of the Medical Tranſactions; and Dr. *A. Fothergill* on Lead.

† For caſes of ſaturnine diſeaſes vid. *Lieutand* Hiſt. Anat. Med. vol. ii. p. 22.

The ſymptoms of lead are eaſily diſtinguiſhable from all the other poiſons. The hard cord-like pulſe has been remarked as particularly attending the lead-colic: it is not however one of the abſolute and particular ſymptoms, which forms a criterion; in inflammatory affections, it generally occurs, and is more or leſs perceptible in all caſes of mineral poiſon. The great characteriſtic mark which diſtinguiſhes this poiſon, is the repreſſion of all the excretions, and the pains and ſpaſms incident thereupon, which, as in the colic, may be ſeen to contract ſome of the abdominal viſcera. The palſy produced by the chronic operation of lead is another. From lead, the muſcular fibres are obſerved to be pale and flabby, and the ſtrength of thoſe muſcles that ſupport the extremities, ſeems peculiarly affected.* But it is unneceſſary to give any other marks of diſcrimination; thoſe who have once ſeen the lead-colic, will not miſtake it, and the length of time both after the diſeaſe has commenced, till it terminates, and before its viſible operation appears, will leave no doubt even to thoſe who have not ſeen it, when they compare the ſymptoms with thoſe of any of the other mineral poiſons.

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p. 22. — *Hoffman* de Metal. Mortif. tom. vi. — *Morgagni* de ſed. & cauſ. lix. p. 375. — *Borellus*, cent. iv. obſ. 3. — *Warren* in Med. Tranſ. &c.

* *Falconer* Mem. Med. London Soc. vol. ii. p. 224.

It is a doubt whether lead applied externally, be equally deleterious as when ſwallowed. *Baker* aſſerts that ceruſſe applied to the excoriated parts of infants, affected them with convulſions; and that litharge externally applied, produced colic.[*] On the other hand, *Haygarth* informs us, that out of fifty-three patients, who were blown up by gunpowder, and whoſe burns and contuſions were very plentifully and frequently waſhed with the ſaturnine water, not one had the ſlighteſt ſymptom of colic or palſy, during the whole time of their recovery, though ſo many *nerves* were expoſed to the immediate contact of lead.[†] The miners employed in extracting the lead-ore from the bowels of the earth, are not more unhealthy than other perſons employed under-ground. But whatever may be the fact with reſpect to the application of lead in ſubſtance or in ſolution to the external parts of the body, the ſame by no means holds good with reſpect to the fumes. The workmen who extract the lead from its ore, and who are conſequently expoſed to its fumes, are liable to all the diſtreſſing ſymptoms of the internal uſe of this metal, which in ſome parts of England they call the belland.[‡] This diſeaſe, which has been obſerved by many

authors,

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[*] *Baker* in London Medical Tranſactions.

[†] *Haygarth's* Letter to *Percival*.

[‡] *Percival* on Lead, p. 112, 117.

authors,* is exactly the ſame as from the internal uſe of lead, and affects other animals as well as man; and as the metal by this mode of application, may cerlainly get into the ſtomach, it in ſome degree ſupports the opinion of thoſe who think it always acts upon the bowels, and unleſs applied immediately to them, that no harm will enſue. Of this, I confeſs I entertain ſome doubt; and yet the fact related by Dr. *Haygarth* is ſo ſtrong, as to hold the mind in ſuſpenſe, between it, and an opinion which ſeems well founded, by the obſervations of *Baker* and *Percival*, and which is ſupported by the analogy of all the foregoing metallic poiſons.

Lead may be taken in the quantity of three or four grains once or twice without injury, in any form; but if this doſe be repeated for any conſiderable time, its effects will be gradually treaſured up, till the tone of the inteſtines is nearly abſtracted, when they will appear in all their malignity. A very large doſe of lead is capable of producing this effect in a few hours, but owing to the irritability of the ſtomach, a quantity capable of producing it will ſeldom be retained long enough. On this account we very rarely hear of immediate bad conſequences

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* Vapores Plumbi Freybergæ, homines metallarios precipue enecant, ideo 17 annis uxores ducunt, & 30 vix ſuperant. — *Haller* El. Phyſ. tom. viii. p. 103, in Addend. in *Plenck* de Venenis, p. 317. —*Mangeti* Bibl. Med. Pract. tom. iv, c. 18. p. 837.—*Hoffman* de Metal. mortif. in Op. tom. vi.

ſequences from this poiſon. There is a wonderfull difference either ariſing from original conformation, or from habit, in the power of different conſtitutions in reſiſting the effects of lead. Some perſons are capable of bearing prodigious quantities, whilſt others are affected with colic and palſy.

In cyder countries it was formerly not very unuſual to mend their troughs and vats with lead. The conſequence was, that the cyder became impregnated with lead, and great numbers of perſons who drank the poiſoned liquor, were affected with colic. But in families it was ſurpriſing to ſee the variety in time and manner, in which different perſons, who drank nearly the ſame quantity of cyder, were affected. Some fell ill in a few days, and were ſoon cured, others reſiſted the poiſon for ſome weeks, but theſe perſons were in general the greateſt ſufferers.

" A girl took eighteen grains of acetated lead, every day for three weeks,* without the ſmalleſt inconvenience."

A weak man, forty years old, took the following liniment at four doſes, in the courſe of forty-eight hours. — Liniment. volatil. ℥iſs. Camphoræ ſacchari Saturni ſingulorum ʒi. — He had no ſick-

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* Acta R. Soc. Med. Havnienſis, vol. iii. 1792.

neſs or pain after it, but great giddineſs and confuſion of the head, with heat in the ſtomach and over the whole body.

At Salford, in Warwickſhire, a perſon ſwallowed near a bottle of *Goulard*'s extract of lead, without any inconvenience.

But though we may ſometimes be ſo happy as to meet with perſons who have eſcaped from the dangers of this poiſon, we ought rather to hope, than to expect, that we ſhall meet with them frequently: for in far the greater number of caſes, injury would have been ſuſtained, by either of the doſes which are related above to have been taken with impunity. In the firſt caſe, more than a drachm of the oxide was taken daily, and on the twelfth day the pains began. In the ſecond, a delicate woman was attacked on the fifteenth day, after ſhe had taken fifteen grains of acetated lead every day, till that time, being in the whole 150 grains. In the one conſtitution, more than 720 grains had only the ſame effect in twelve days, as 150 had on the other in ten. But in much ſmaller quantities than either of theſe, I believe it is capable of producing its worſt effects; as I am told by a phyſician of great experience,* that the pains have come on in caſes under his obſervation, from doſes of three or four grains of the acetated lead, daily, continued only a week.

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* Dr. *Johnſtone*, of Worceſter, to whom I am indebted for two of the foregoing caſes of the effects of lead.

I cannot ſay much on the degrees of virulence of the different preparations of lead. If we may reaſon from the action of the metal and its oxides when taken into the ſtomach, it is to be inferred that they are all noxious, without any great difference of degree: and lead is one of thoſe metals, which is ſo eaſily diſſolved by the weakeſt acids, that wherever it is expoſed in the preparation of our food, there is danger of its being taken into the ſtomach.

The preſence of lead in ſolution is diſcoverable by liver of ſulphur, when there is no calcareous earth diſſolved along with it. — *Bergman* recommends the following teſt for the diſcovery of lead, in all circumſtances. " Boil a certain quantity of orpiment in water, and add double the quantity of quick-lime. The clear liquor will precipitate lead of a browniſh colour." — But *M. Fourcroy*, in his memoir on this ſubject, has ſhewn the uncertainty of all theſe precipitants, and recommends in their ſtead, water impregnated with hepatic air, which diſcovers lead in the moſt minute portions: a very brown cloud (brun-noiratre) being apparent, if 000,10 of the tartarite of lead, or indeed any other of its neutral ſalts, be diſſolved in the liquor.* This precipitant is particularly uſeful to detect the villainy of thoſe who are induced by their avarice to poiſon our wine and our oil with lead, in order to correct the acidity of the one, and the rancidity of the other.†

On the time in which the preparations of lead will produce their effects, there is ſuch a variety of opinion, founded on ſo great and complicated a variety of obſervation, that I can ſpeak but with little confidence.

I have never ſeen any immediate apparent operation from the uſe of lead in man: on animals, in a very large doſe, it produces ſickneſs immediately, with very great uneaſineſs, convulſions, and death in the ſpace of two days. This fact I have ſeen exemplified on a cat. In *Sproegel*'s experiments, the ſickneſs was immediate, and convulſions acceded in a few hours, from lead. — In the caſe of the ducks and geeſe, related by *Percival*, the animals all died during one night; and he relates ſome others, in which the effects were produced as ſoon, on ſmaller birds. — But in the human body, the operation is by no means, for the moſt part, ſo quick in its appearance. When the doſe is very large, and not diſcharged by vomiting, the ſymptoms will undoubtedly appear in the courſe of eight or ten hours; and we know, without any reſort to analogy, that from ſmaller doſes, repeated, they have often appeared in their worſt degree in the ſpace of a week, and terminated in three or four days.

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* Mem. de l'Acad. R. des Sciences, 1787, p. 288.

† The cuſtom of rendering ſour wines ſweet, by lead, is too notorious ever to be denied, and is taught in cookery books, with many other choice receipts for poiſoning pickles with copper, in order that their green colour may be more beautiful.

" In Holland it has been cuſtomary to correct the more offenſive ex-
" preſſed oils, ſo as to ſubſtitute them for oil of olives and almonds, by
" impregnating them with lead." — Vid. Fothergill's Cautions on the poiſon of Lead.

I ſhall avoid any thing that may lead to a diſcuſſion concerning the ſedative power of Lead, a power which has been ſo warmly ſupported, and which has been ſuppoſed almoſt appropriately its own. The painful and obvious action of this poiſon on the alimentary canal, ſeems to afford us a better clue to its operation, than a diſcuſſion of terms, to which no exact ideas have yet been attached. But there are other circumſtances which ſeem to point out, that a great injury has been ſuſtained by the ſyſtem at large, independent of that viſible one, which the receptacle of a poiſon always ſuffers.

From lead, the bowels are affected with pain and ſpaſms, the muſcular fibres become pale and flabby, and palſy, or loſs of voluntary motion of the muſcles, ſucceeds—From arſenic, moſt excruciating pain of the ſtomach is ſoon followed by tremors, and loſs of life; and after death, by ſudden diſſolution of the texture of the body. In the one caſe, there is a ſlow and ſilent abſtraction of that power which conſtitutes life, and action is deſtroyed without much apparent ſolution of texture: whereas in the other it is quick, and the ſolution of texture is apparent—In both caſes I have hinted before, that the effect is the ſame, though the cauſe producing it, varies the appearance of its abſtraction in many different ways, and in many different periods, from circumſtances in the conſtruction of animal bodies, and in that of poiſons with which we are not acquainted.

From all poiſons, the action commences on the alimentary canal when they are firſt applied to it, and from thence is communicated to the reſt of the body. From lead, the caſe is not different; the want of action of the inteſtines gives the firſt alarm of danger, the nerves being ſtimulated by the congeſtion of aliment, or perhaps by ſome peculiar ſtate of the fibres ſurrounding them, to violent pain, the reſt of the ſymptoms accede in courſe. Dr. *Haygarth*'s caſes are deciſive in proving that lead does not act ſolely on the nerves.

The cure of thoſe poiſoned by lead, muſt be undertaken with the intention of diſcharging the poiſon, or of correcting its virulent ſymptoms.

The firſt indication can never be ſo ſucceſsfully purſued when the poiſon has been taken for ſeveral days, as when it has been lately ſwallowed; in no circumſtances, however, ſhould we loſe ſight of the intention of diſcharging it. For though it be taken in ſmall quantity for a length of time, we are not to truſt to its being expelled along with the other ingeſta. Moſt probably ſome part will be collected in the inteſtines, while the reſt is ſilently exerting its baneful influence on the conſtitution. In all caſes, therefore, but more particularly when it has been taken in any large quantity, the firſt attempt ſhould be to diſcharge the poiſon. For this purpoſe, emetic tartar diſſolved in water, and adminiſtered by degrees, ſeems admirably adapted, as its operation moſt probably will not be confined. If, however, it ſhould not act by opening the body, ſome briſk cathartic muſt be employed till this effect is produced. With aloes or calomel, ſcammony, the extractum colocynthidis compoſ. of the London Pharmacopeia, caſtor oil ſhould be generally employed in conſiderable doſes for this purpoſe, and ſometimes even it may be neceſſary to have recourſe to the fumes of tobacco: but the choice of the particular cathartic muſt be always left to the judgment of the practitioner. Where the milder ones will ſucceed, it is uſeleſs, and even dangerous, to employ thoſe that are ſo violent in their operation, as the preparations of tobacco; but when the bowels have loſt much of their irritability, the moſt violent ſtimulations are often neceſſary to excite them into action. Theſe ſtimulating medicaments may be given in glyſters, as well as by the mouth, and very ſimple and mild means will often have the effect of opening the body, when adminiſtered in this form, though ſtrong and active cathartics were previouſly adminiſtered by the mouth in vain. Often likewiſe, when the fæces have been long collecting in the inteſtines, their hardneſs contributes to coſtiveneſs; this ſtate may be eaſily remedied by the copious uſe of diluents, which divide the hardened excrements, and lubricate the paſſage. In all theſe caſes, oils ought to be given plentifully, and indeed their advantages are ſo many and ſo great, that no ſlight objection ſhould be ſuffered to weigh againſt them. The diet ſhould conſiſt principally of broths, jellies, &c. which can hardly be taken in too large a quantity, unleſs the body is ſo obſtinately coſtive, as to render their accumulation in the inteſtines incommodious. If by diſcharging the poiſon, its painful and deleterious conſequences are not removed, we muſt have recourſe to the ſecond intention of cure. But before we attempt to relieve pain, or to ſubdue paralytic affections, it muſt always be remembered, that no hope of benefit can be entertained, till the motions of the bowels are in ſome degree regulated. All the opiates and tonics we can adminiſter, will rather prove injurious, or of little avail, till this is accompliſhed. But when it has been accompliſhed, if the pain and ſpaſmodic affections continue, then may opiates be adminiſtered both in mucilaginous draughts and glyſters, and in conſiderable quantity: for the inteſtines, and indeed the whole body, become inſenſible to the ſmaller ſtimuli after a long uſe of the poiſon of lead.

From the firſt, the application of warm water will be found ſerviceable in alleviating the painful ſpaſms; and through the whole courſe of the diſeaſe, warm baths impregnated with ſulphur and mineral alkali, will be uſeful in correcting the effects of the poiſon. For the relief of the paralytic affections, and for the reſtoration of the tone of the ſyſtem, many remedies are propoſed by authors.— Dr. *Percival* recommends alum as a tonic peculiarly adapted to ſaturnine diſeaſes. Of this remedy I cannot ſpeak from my own experience, though I think it well deſerves notice. In general, the cure of theſe affections is ſucceſsfully purſued by the employment of electricity, and the aromatic ſtimulants, but ſometimes we find all our efforts vain;

tone is too much abſtracted to be reſtored, and the patient at laſt ſinks under an univerſal defect of bodily action. In ſuch caſes, no other general direction of cure can be given, than that in the choice of remedies the ſtimuli be applicable to the conſtitution and the ſtrength of the patient.

IT would have been vain to attempt compriſing every thing that is known or has been written on the ſeveral metallic poiſons and their cure, within the narrow limits of an Eſſay. Each of them conſidered to its full extent would fill a volume. I have only therefore endeavoured to draw ſuch a ſketch, as ſhall be ſufficient to mark one from the other, and to direct even thoſe who are unacquainted with the properties and the powers of medicaments, what may be immediately done in caſes of ſuſpected poiſon, till a medical practitioner can be called. In this view, what I have written cannot be deſtitute of utility, and on this account I have reſted upon ſome, as they may at firſt ſight appear, trifling topics. In diſcriminating the poiſons from each other, I have been more diffuſe; and I hope have given ſuch diſtinctive marks of the mode of operation, and of the appearances of each, as ſhall leave as little room for miſtake as poſſible. Not that it is poſſible, to comprehend all the varieties of complication within any one ſet of definitions or deſcriptions.

I have before given my reaſons for not including zinc and biſmuth in the number of mineral poiſons. Dr. *Cullen*[*] quotes *Hellot* as giving inſtances of the deleterious powers of zinc; but as I have not been able to procure *M. Hellot*'s work, it is impoſſible for me to know upon what data the opinion is founded. Thus far I know from my own experience: that eighty grains of vitriolated zinc taken at one time, and that ten grains of the flowers of zinc taken three times a day for more than three weeks, were innoxious in the firſt caſe to a woman of twenty-three, and in the latter to a boy about fourteen years old: nevertheleſs, we ought always to be cautious, where our knowledge is not preciſe.

Were all the active medicines to be ranked among the poiſons, our definition of thoſe deleterious powers would be confined to ſtimulant action, which I fancy no one will allow to be the caſe.

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[*] Mat. Med. vol. ii. p. 30.—The learned Profeſſor ſeems to have great objection to vitriolated zinc as an emetic, on account of the long continuance of its operation. For this reaſon, it is the moſt proper emetic that can be given in caſes of poiſon.

Biſmuth is in ſuch common uſe as a paint, that its poiſonous qualities muſt long ago have been diſcovered, were they powerful.

Of the other ſemi-metals, Manganeſe has lately become an object of much curioſity, from the abundance of oxygene which is procured from its oxides. I am informed by good authority, that when given to dogs it does them no harm, but on the contrary, makes them more lively.

An elderly fat man, took by my direction, ℥ſs. of a black oxide of manganeſe, in the courſe of a week, without the ſmalleſt pain, or perceptible injury.

On this ſubject I ſhall beg leave to ſubmit a caſe to the deciſion of the medical reader.

In May, 1794, I was deſired to ſee *John Groves*,* æt. thirty, who had been affected four months before with grievous pain of his bowels, obſtinate coſtiveneſs, dyſury, and loſs of voluntary motion of the lower extremities. His employment, previous to his illneſs, was bleaching rags, to make paper, at which he worked more than a year. From the firſt, he was diſagreeably affected by the duſt of the manganeſe, which was very offenſive to his throat, aud by the fume which aroſe from the mixture of this mineral with vitriolic acid and common ſalt. He took by my direction the following pills, with an infuſion of muſtard ſeed; and a bliſter was applied to the lower part of the back.

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* Since dead.

R. Pil. hydrarg. conſerv. ari, ſingulorum drachmam. M. & div. in pil. xxiv. [quarum ſum. ii. mane & veſp.

The warm bath and electricity were alſo recommended, with a cordial diet, but I believe from the inconveniency of his ſituation, not applied. The pills kept his body open for ten days, when they loſt their effect. As he lived more than twenty miles from Worceſter, I had no opportunity of ſeeing him again, but recommended him to the Infirmary in that city, where he was brought in September following, in much the ſame ſtate I ſaw him in May. The paralytic ſymptoms, coſtiveneſs, and dyſury, continued as great as ever. He was diſcharged in November, not relieved, after taking neceſſary purges, with proper ſtimulants, under the direction of Dr. *Cameron*: bliſters alſo were applied, and various other remedies, but in vain.

He was a very healthy man before his ſeizure, and unlikely to have any paralytic affection. At firſt I ſuſpected that lead might have occaſioned

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his complaints, as the attack ſeemed remarkably ſimilar to that of the lead colic; but I found, that lead could not poſſibly have occaſioned them, unleſs the manganeſe was impregnated with it. I have learned ſince, that the poor man's wife being ill, he was not undreſſed for a whole month, during which time he often lay upon a ſtone floor near a fire. Immediately after this he had a violent attack of rheumatiſm, and ſoon after was affected with the pain in his bowels, and palſy of the lower extremities. None of the other workmen employed in the ſame buſineſs, have been affected: and the maſter of the paper manufactory has provided againſt any future bad conſequences, by a contrivance for mixing the manganeſe, vitriolic acid, and ſalt, without expoſing the workman to the duſt or the fumes, ariſing from the mixture.

Whether the obſtinate and terrible diſeaſe of *Groves* was occaſioned by his employment, is at leaſt doubtful, when all the circumſtances of his caſe are conſidered. It cannot however be unprofitable to aſcertain facts of ſuch importance as thoſe which relate to the health of manufacturers, and to provide by every means in our power againſt the ſuſpicion of miſchief: particularly with reſpect to manganeſe, which is likely to be employed ſo largely in the preſent ſtate of medicine, we cannot

not be too anxious in collecting every fact, which has the ſmalleſt tendency to elucidate its properties.

I ſhall now proceed to give an account of the Earthy and Saline Poiſons.

II.

EARTHY POISONS.

1. LIME.

WHEN calcareous earth is deprived of its carbonic acid, by the action of fire, it becomes cauſtic, and forms the ſubſtance ſo well known by the name of quick-lime. In the ſtate in which it is generally met with, it is inert, and none of its compounds are in any degree ſo active, as to render them deleterious. The poiſonous action of lime, therefore, depends upon its mechanical cauſtic qualities.

" The ſon of the ſurgeon *Hioſeppus*, a boy of " eight years old, was accuſtomed to eat hair, and " the rubbiſh of old walls. By chance he met

" with ſome quick-lime, of which he eat ſo abundantly, that he immediately fell into a violent fever, with urgent thirſt: he drank a good deal, but his thirſt was never allayed: he complained of excruciating pain of the ſtomach and the throat, threw up every thing that was given him, and could not taſte any thing. He died on the ninth day after the accident."[*]

The ſymptoms related here, are thoſe of active inflammation of the mouth, throat, and ſtomach, ſuch as may be inferred will generally occur in ſimilar caſes—Violent fever, with inſatiable thirſt, excruciating pain of the ſtomach, burning of the throat, and vomiting of every thing that is ſwallowed.

In a dog, lime alſo excited the diſcharges by urine and by ſtool.[†]

The quantity of quick-lime to produce theſe effects muſt be conſiderable. Carbonic acid enters ſo largely into the compoſition of every article of food and drink, that a ſmall portion would be immediately rendered mild. I think we may fairly eſtimate, that at leaſt half a drachm of quick-lime,

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[*] Amati Luſitani Curat. Med. cent. v. cur. 91.—For another inſtance in which lime was fatal, vid. *Mangeti* Bibl. Med. Pract. tom. iv. p. 851.

[†] Calx cani obtruſa, alvum & urinam movit, miſerumque animal emaciavit.—*Schinz* de Cace in *Haller* El. Phyſ. vi. p. 215.

will always find a ſufficient quantity of carbonic acid in its paſſage to the ſtomach, to neutraliſe it; and its cauſtic unpleaſant taſte, will prevent any more conſiderable quantity from being heedleſsly ſwallowed.

The ſymptoms of inflamation of the ſtomach from lime, will be different from the ſame affection produced by cold, in no reſpect, except that in the former caſe, the inflammation will extend to the mouth, fauces, throat, and whatever parts are touched by this cauſtic mineral. Unleſs the quantity of lime ſwallowed be very large, corroſion of the ſtomach will not take place, as there will be generally a ſufficiency of fluid either preſent, or ſecreted from the ſtimulation of the poiſon, to prevent this effect. If however ſuch a caſe be ſuppoſed as that, in which a larger quantity of lime is ſwallowed, than can be provided againſt, by all the efforts of nature, and all the fluid and carbonic acid preſent, accidentally in the ſtomach, corroſion will undoubtedly take place.

The appearances of the ſtomach after death from lime, will be thoſe of inflammation, mortification, and poſſibly corroſion; theſe appearances will extend as far as the lime has reached, and may be ſeen wherever it has touched.

If quick-lime be found in the ſtomach, its common appearance and taſte will be ſufficient evidence. It may be known moreover by forming gypſum with ſulphuric acid, and white turbid mixtures, in liquids, impregnated with carbonic acid.

The time in which the inflammation produced by quick-lime terminates, will of courſe be varied by age and conſtitution. The child above-mentioned died in nine days — Inflammations of the ſtomach have terminated fatally in eighteen hours, and they have continued for fourteen days.

The action of quick-lime is nearly the ſame as that of the other corroſives: by its ſtimulant power, it excites inflammation, and in ſufficient quantity will deſtroy the texture of whatever parts it touches.

Externally applied, lime may certainly produce very troubleſome and dangerous ulcerations, or even the deſtruction of an organ. It is unlikely however that the forbearance of any individual will be ſo great, as to ſuffer it to remain long enough upon any part to have this effect; and guilt will hardly employ a mean ſo clumſy for the perpetration of its diabolical purpoſes.

It will be ſo eaſy to correct the deleterious powers of quick-lime, that the intentions of cure muſt be directed to this end, rather than to the diſcharge of the poiſon. For this purpoſe all liquors impregnated with fixed air, and all mixtures that extricate it, may be poured into the ſtomach; ſuch as bottled perry or porter, freſh beer, and the common ſaline efferveſcing mixtures. If none of theſe remedies are at hand, copious draughts of water, and gentle emetics, may be given. After a ſufficiency of them hath been employed to neutraliſe the quick-lime, or to diſcharge it, the uſual remedies of active inflammation ſhould be reſorted to, and vigorouſly perſiſted in, till all danger is paſt,

2. BARYTES.

THE ponderous earth is uſually found either vitriolated or aerated: but both the ſulphuric and the carbonic acid can be expelled from it by the action of fire, and it then becomes cauſtic, ſimilar, in many reſpects, to quick-lime.

Of barytes I have little knowledge: I have taken it in its aerated ſtate, to the quantity of ten grains, without any inconvenience.

The compound of barytes with the muriatic acid, is ſaid to be poiſonous to animals — I have ſeen a delicate female take thirty drops of the ſaturated ſolution repeatedly in the courſe of a day, without even nauſea. It will require therefore at leaſt two or three drachms to do miſchief.

Of the peculiar powers of barytes, I can ſay nothing. Much has been written on its value as a medicine, but it is now almoſt laid aſide.

For the action of quick-barytes, I muſt refer to what has been already ſaid on lime. The cure in all reſpects will be the ſame, except that if aerated barytes be deleterious, there will be a greater neceſſity for the uſe of active emetics in this caſe.

Barytes may be diſtinguiſhed from lime, by its gravity. It forms a deliqueſcent ſalt with acetous acid, whereas lime is converted into a chryſtalliſable ſalt.

3. SILICIOUS EARTH.

IN the ſtate in which it is uſually found, ſilicious earth is no more hurtful, than any of the other common ſorts of earths: but in combination, it forms a ſubſtance, which, from its hardneſs and ſharpneſs, is capable of doing great miſchief when taken into the bodies of animals. Fuſed with a quantity of fixed alkali, ſilicious earth is converted into glaſs. This ſubſtance, ſo eſſential to convenience, and ſubſervient to luxury, when broken into ſmall pieces, affords innumerable ſharp points.

There are many caſes on record, in which broken glaſs taken into the ſtomach, proved fatal. "We read in *Fabricius Hildanus*, that the king's guards having got drunk, broke their glaſſes with their teeth, and all periſhed from ſwallowing the pieces."* Many other inſtances are referred to in *M. Hevin*'s memoir, which I ſhall not enumerate.

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* *Hevin* Mem. ſur les corps etrangers, dans l'œſophage, in Mem. Ac. R. de Chir. tom. ii. p. 393.

The action of glaſs is merely that of an irritating cutting ſubſtance, which will lacerate the ſtomach, or produce an inflammation of the leaſt remediable kind, as it will be very difficult to get rid of the irritating matter. A very ſmall quantity will be ſufficient to produce theſe effects. If the pieces be of a large ſize, the œſophagus moſt probably will be lacerated, in their paſſage to the ſtomach; and this is a certain cauſe of death if the wound take place in the thorax. It is evident that the danger in all caſes will greatly depend on the ſize of the pieces of glaſs ſwallowed. When finely powdered, there is much leſs danger than when the pieces are of ſuch a ſize as not readily to be returned by vomiting.

Fatal as the effects of ſwallowing glaſs have been, there have not been wanting perſons who made a profit of ſwallowing it, and ſometimes without immediate injury to their health:* but there

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* "Quid quero ſentis de Vitrivoris. Ego hic in vicinia tres cognovi viros robuſtiſſimos, quorum duo adhuc vivunt & quidem ſatis commode: tertius vero ante annos duos ex phthiſi obiit: hi vitra quamplurima veluti cum aviditate devorarunt. Jam cupio vir ampliſſime ex te ſcire, quomodo fragmenta illa, ventriculum & inteſtina partes exquiſitiſſimo ſenſu præditas, ſine mortis periculo pertranſire potuerint. Habet quidem Manlius in ſuis collectaneis exempla aliquot de Vitrivoris, ſed inſolentiæ ac ſtultitiæ ſuæ pænas meritiſſimas morti perſolverunt. —— De his vide tractatum, Den *Chriſtlichen Schlafftrunck.* — *Hildani* Obſ. Chir. cent. iv. obſ. 2. p. 211.

"Nuper

there are few exceptions to the general rule, for many who made the ſame attempt, have paid for their raſhneſs with their lives.

The term of operation when glaſs has been ſwallowed, will depend upon the injury done to the œſophagus or ſtomach. If large blood-veſſels are cut through, life may terminate in eight or ten hours: if inflammation ſupervenes, in eighteen hours, or it may continue for many days.

Flints and chryſtals, if they are ſharp, will have much the ſame effect as glaſs; in general, however, they are much more obtuſe, and conſequently much leſs dangerous.* Needles, pins, ſharp pieces of ſwords, may have the ſame effects.

From the corroſives, all theſe mechanical irritants, may be diſcriminated by their not inflaming the fauces, even though the patient ſhould conceal the real cauſe of his calamity. Neither will the pain they occaſion, be attended with ſo much anxiety or debility.

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" Nuper Veterator per patriam meam iter fecit, puerumque circumduxit, quem aiebat, mala fabula uſus, in deſerta inſula, ab ipſa neceſſitate compulſum, lapides didiciſſe edere. Deglutiebat utque miſer ſilices Sed inventum eſt, nebulonem infelici puero ſub noctem, purgans medicamentum obtruſiſſe, ex quo multo cum dolore lapides decederent. *Haller* El. Phyſ. tom. iv. p. 214.

[*] Qui homines ſilices deglutierunt, magnos inde dolores, & languores paſſi.— *Haller* El, Phyſ, tom. vi. p. 214. From Phil. Tranſ. No. 253.

The cure muſt entirely depend upon the ſize of the pieces of glaſs ſwallowed. If they were large, went down with difficulty, and lacerated the paſſage, I ſhould much fear, that miſchief rather than good, would be done by the exhibition of active emetics; on the contrary, they may be given with advantage, if the pieces ſwallowed were of ſuch a ſize as to render their expulſion probable. Oil always ſhould be poured down in large quantities. In thoſe caſes in which the return of the pieces of glaſs is improbable, may not the fluoric acid be given with advantage? The whole catalogue of *Mithridates* will be here of litttle avail. All that is to be done, is to ſheath the ſtomach, and diſcharge the offending matters as quietly as we can.

III.

SALINE POISONS.

1. MINERAL ALKALI.

THIS production is one of thoſe, which Nature has beſtowed with the moſt liberal hand. It is not only diffuſed through the waters of the ocean, and piled in immenſe maſſes on many regions of the earth, but alſo enters into the compoſition of many vegetables. In its common ſtate, mineral alkali is an active medicine, and adminiſtered in large quantities may do miſchief; but it is more particularly entitled to a place here, when pure, uncombined with the carbonic, or any other acid. In this ſtate it is called cauſtic mineral alkali, and if taken into the ſtomach, will inflame it and the œſophagus through their whole extent, and finally corrode and deſtroy their texture.

The ſymptoms, and the appearances after death, are nearly the ſame, from all the corroſive poiſons, as well as the duration of the ſymptoms. They all deſtroy life by producing the worſt effects of inflammation, in the ſhorteſt time.

It will require a pretty conſiderable doſe (perhaps eight or ten grains) of cauſtic alkali, to deſtroy texture, as a ſmall one will be neutraliſed by the carbonic acid it meets with in the paſſage, or by the contents of the ſtomach itſelf. But although neither the œſophagus nor ſtomach can be corroded by a ſmall quantity, yet may dangerous inflamation be excited even by the contact of ſuch acrid ſubſtances; they are therefore much to be feared even in the moſt minute doſes, and ought never to be adminiſtered internally, without great caution.

Both the cauſtic alkali alone, and in conjunction with lime, is frequently employed externally as a corroſive, to deſtroy fungous fleſh, warts, &c. and may certainly be very injurious to health, or even deſtructive, when injudiciouſly or malignantly applied. In all caſes, the injury done muſt depend upon the importance of the part corroded. By the external application of a cauſtic, ſight may be deſtroyed, and even life, if the corroſion is ſuffered to extend to arteries and nerves.

Alkalies may be diſcriminated by the compounds they form with acids—If they are ever found cauſtic, a ſlight trial of their effects will leave no room for miſtake; and in this ſtate they will not efferveſce with acids. They may be known likewiſe by turning ſyrup of violets green.

Alkalies form, with quick-lime, compounds little leſs corroſive than the pure alkali alone. All the bad conſequences of the cauſtic alkali, will reſult from its combination with lime, if they are taken internally, or applied externally, in ſufficient quantity.

The cure is clearly indicated in all theſe caſes by chemical affinities. If we impregnate the cauſtic alkali with carbonic acid, we render it comparatively mild. The ſame purpoſe is anſwered by neutraliſing it by any other acid which may be at hand. Aerated water, or bottled perry, or any of this kind of liquors is excellent; even freſh ſmall beer, or large quantities of water, will anſwer the intention, when the more powerful correctives are wanting. If inflammation has ſupervened, and we are confident that the alkali is rendered mild, it muſt be remedied, by the uſual antiphlogiſtic plan.

The compounds of mineral alkali with acids, though active, are ſeldom ſo violent in their operation, as to produce dangerous conſequences. That with the carbonic acid is the moſt active, and ſhould always be diſcharged by an emetic, when taken in large quantity.

What has been ſaid of the cauſtic mineral, is equally applicable to the cauſtic vegetable alkali. They are not to be diſtinguiſhed either in appearance or effects, in their pure ſtate, being only diſcriminable by the difference of their compounds.

2. SULPHURIC ACID.

WHAT I ſhall ſay of the corroſive powers of this acid, will be equally applicable to the other two. In their concentrated ſtates, they are all corroſive to a very great degree; and as their qualities are nearly the ſame, they are ſcarcely to be diſtinguiſhed one from another. Swallowed in an undiluted ſtate, the ſulphuric acid violently ſtimulates the fauces, œſophagus, and ſtomach, and if it remain ſufficiently long, corrodes them. When, therefore, it is taken in ſufficient quantity, and not inſtantly diſcharged, which from its ſtimulating nature it is likely to be, all the ſymptoms of inflammation will quickly accede, with exceſſive pain of the ſtomach, burning heat in the mouth and throat, thirſt, ſickneſs, vomiting often of blood, &c. Theſe will terminate in mortification and death, unleſs they are ſpeedily and judiciouſly relieved.

After death, the ſtomach will be found inflamed, mortified, and perhaps corroded,* as well as thoſe other parts touched by the acid.

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* *Lieutaud* Hiſt. Anatom.—Med. tom. i. p. 35.

The time which ſulphuric acid takes to produce its worſt effects, will be varied by the quantity ſwallowed, the ſtate of the ſtomach at the time, and the age and conſtitution of the patient. I believe that the ſulphuric acid has never been ſuppoſed to poſſeſs any other deleterious qualities than thoſe which are derived from its corroſive properties. From theſe violent ſtimulants, inflammation has never been known to terminate in leſs than eighteen hours. But when all the bad ſymptoms have been removed, I have known very painful affections of the ſtomach, with general diſorder of the ſyſtem, continue for ſome time; and in one caſe, where two ounces of ſulphuric acid ſwallowed by miſtake, were immediately diſcharged, a degree of encreaſed ſenſibility has ever ſince affected the patient, with diſeaſe of the liver and the ſtomach.

It is not eaſy to fix the preciſe quantity of ſulphuric acid that will prove hurtful. One would think that the extremely acrid taſte would always be a ſufficient warning againſt ſwallowing much, yet has it been taken unintentionally to the quantity of two ounces. This doſe may produce the worſt conſequences that can be produced by the ſulphuric acid; and I believe down to the ſmall quantity of a drachm in its concentrated ſtate, it may prove very hurtful, unleſs there be ſo much fluid in the ſtomach as to dilute it, or unleſs it be inſtantly diſcharged.

The cure muſt be attempted in the firſt place by neutraliſing or diluting the acid, and then by diſcharging it. Alkali of any kind, or abſorbent earths, will completely anſwer the firſt intention, if they are given in plentiful draughts of water: when they are not ready, the water ſhould be given alone. In this, and indeed in all other caſes of ſuſpected poiſon, it is of the utmoſt conſequence, that diluents of every kind ſhould be uſed in abundance. In innumerable caſes they may preſerve life, in hardly one, can they injure health. They are ſimple, but ſovereign remedies, which the bounty of providence has placed in every body's hands, without the power of abuſing them.

3. NITRIC ACID.

THIS acid, in the ſtate in which it is uſually procured, is more corroſive than the ſulphuric, and perhaps poſſeſſes ſome deleterious qualities not inherent in either of the other two mineral acids. It is not however in its pure concentrated form that the difference is obſervable, as nearly the ſame quantities of all of them will produce ſimilar effects. In the form of gas, and in conjunction with alkalies, nitre aſſumes a character, which has not in all circumſtances been accurately appreciated. But we know from experiment, that the gas injected under the ſkins of animals, produces deleterious effects, * which are not produced by many other kinds of air; and that the neutral ſalts of nitre, are injurious in much ſmaller quantity, than thoſe of any other acid.

The pure acid of nitre produces nearly the ſame ſymptoms as have been enumerated under the preceding article. It will perhaps act in a ſhorter time, and in ſmaller quantity, than the ſulphuric acid: but there are no data by which to eſtimate the difference, and I do not conceive, that of either will be ſo great as to deſerve notice.

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* *Reddoe's* Conſiderations, p. 21.

The compounds of nitre with alkalies, are all very ſtimulating, though not corroſive, and have occaſioned death in no very conſiderable quantity. An ounce of the common nitre has been known to deſtroy life;* and although perſons have eſcaped after taking two ounces,† yet it was with much riſque. In the latter caſe, the man who took it, was immediately affected with violent pain of the ſtomach and bowels. In about half an hour he began to vomit, and he continued vomiting for two or three hours, when he threw up blood. He was bent forward, and could not riſe without the greateſt pain. An affection of the ſtomach and bowels continued a long time, after the urgent ſymptoms were relieved.

In the quantity of half an ounce, the effects of nitre are to be feared. In delicate conſtitutions it may produce inflammation,‡ which will be always the apparent operation, from this ſalt, with the ſymptoms deſcribed in the caſe above related.

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* *Pyl*'s Repertorium fur die offentliche, &c. ſect. 5.

† *Falconer* in Mem. Med. Soc. London, vol. iii. p. 527. — For another caſe in which nitre was ſwallowed by miſtake in large quantity, ſee *Alexander*'s Experimental Eſſays, p. 107. note.

‡ Nitre is ſo commonly uſed, and in the general opinion of phyſicians with ſo much efficacy in all caſes of active inflammation, that it may appear ſingular to ſay it produces the ſtate which it is ſuppoſed to remedy, when adminiſtered in too large quantity. Of late, nitre has been much given in typhus, and if we credit the accounts, with benefit. What ſhall we ſay then of its action; and how can we account for its uſe in caſes ſo oppoſite?

In *Alexander*'s experiments, (14, 15,) two drachms and a half of nitre produced very alarming effects, when taken immediately after ſolution in water: but the ſame quantity after the ſolution had ſtood ſome time, was entirely inoffenſive.

The nitrous acid may be diſtinguiſhed from the others, by forming cubic chryſtals with the mineral alkali; and by flying off in red acrid vapours, when expoſed to heat,

The cure muſt be undertaken with the ſame intentions, as in the caſe of ſulphuric acid. To neutraliſe nitric acid indeed, it will be better to uſe calcined magneſia, and the other abſorbent earths, than the alkalies; but if the latter are ready, and the others are not, they ſhould be employed, with large quantities of water, milk, oil, or any bland fluid. With them, ipecacuan ſhould be given in moſt caſes, and particularly when the common nitre has been taken, it may be truſted to, without any other addition than the diluents.

4. MURIATIC

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oppoſite? However theſe queſtions may be anſwered, ſtill it ſhould be remembered, that ſome preparations of antimony, which are violently ſtimulating in large doſes, are moſt beneficial in all diſeaſes of active inflammation.

4. MURIATIC ACID.

IN the account of this acid, nothing can be added to what has been already ſaid under the two former articles. In its action, the muriatic is probably moſt ſimilar to the ſulphuric acid, as its corroſive properties alone conſtitute its deleterious powers.

All the acids are corroſive in proportion to the quantity of oxygene united with them. The muriatic can be united to an over-proportion without much difficulty, and aſſumes ſuch new properties from the union, as make it an uſeful article in many manufactures. Hence it is liable to abuſe, and therefore ſhould be guarded againſt with vigilance.

The ſymptoms will be nearly the ſame from the ſame quantity, and in the ſame time, as well as the effects, and the appearances after death, from the muriatic, and the other mineral acids.

The muriatic acid will be diſtinguiſhable from the other two, by the mildneſs of its compounds, and by forming common ſalt with mineral alkali.

The cure is the ſame, as of the ſulphuric acid.

The compounds of the mineral acids with each other, are all corroſive. That of the nitric with the muriatic acid, is probably the moſt active. They will have the ſame operation, and muſt be remedied by the ſame means, as already deſcribed.

TO what claſs of poiſons the AQUA TOFFANA of the Italians is to be referred, I know not, as happily I have had no opportunity of ſeeing it, or obſerving its effects. Some authors think that it conſiſts of arſenic, diſſolved in a large quantity of water;[*] and others, that it contains lead. Whatever its compoſition may be, it will be eaſily detected, both by its operation, and by chemical analyſis, if it contain either of theſe poiſons.

The PULVIS SUCCESSIONIS,[†] is ſaid by *Plenck*[‡] to conſiſt of ſugar of lead, and a ſmall quantity of arſenic; and by *Hevin*,[||] to be only powdered diamond.

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[*] *Plenck* de Venenis, p. 335 From *Gmelin*'s Mineraliſche gifte, p. 131.

[†] For an account of the dreadful manner in which this poiſon was uſed by the Marquiſe de *Brinvilliers*, and her paramour *St. Croix*, who learnt the ſecret from an Italian, vide Abrege des Cauſes celebres, tom. i. p. 47.

[‡] *Plenck* de Venenis, p. 336.

[||] Mem. Acad. R. de Chir. tom. ii. p. 393.

mond. (Diamant pulveriſe.) The accuracy of modern chemiſtry would ſoon clear up this matter, ſhould it ever be brought into diſpute. Fortunately, our country has never been ſcourged by thoſe direful and malignant paſſions, which give birth to new modes of torture and deſtruction. Crimes indeed are the offspring of every nation, excreſcences of wants and infirmities, which will deform even the moſt perfect of human ſocieties. But it is only under the direction of ſuch monſters as a *Nero*, a *Caracalla*, or *a Borgia*, * that theſe diſeaſes ſpread ſo widely, and take ſo deep root, as to affect the very vitals of ſociety. When the ſon armed againſt his father, and the wife againſt her huſband, are ſolicitous not about thoſe means that ſhall gild life with comfort and ſatisfaction, but only about thoſe, that may produce the greateſt ſum of miſery, with the leaſt poſſible chance of detecting its cauſe. At ſuch a moment, and in ſuch a ſociety, was the aqua toffana diſcovered; and the invention and hiſtory of the pulvis ſucceſſionis, affords an inſtance of depravity and barbarity, that muſt make us bluſh for our nature.

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* *Nero* gave rewards to thoſe who diſcovered poiſons, and had perſons inſtructed in the art of preparing them. *Suetonius*, lib. vi.—If the quantity of poiſon contained under the gem of a ring, really avenged the ſlaughters of Cannæ, the ancients muſt have known much more powerful ones than we are acquainted with.

Caracalla had vaſt quantities of poiſon by him at the time of his death, "that he might ſecretly deſtroy as many perſons, in as many different ways as poſſible." *Dionis. Anton. Caracal.* 22.

Hiſtory is full of the infamy of *Alexander Borgia*, the ſupreme pontiff, and his ſon *Cæſar*. The ſon narrowly eſcaped from, and the father fell a victim to poiſon, which they had prepared for ſome cardinals.

With us, the caſe is widely different. Inſtead of encreaſing the catalogue of theſe deadly powers, we have converted many of them into the means of health; and although unable to prevent the evils neceſſarily ariſing from their injudicious or malignant uſe, yet have we mitigated, and in ſome meaſure counterbalanced them, by their application to the unavoidable calamities of our imperfect condition.

I have thus finiſhed my ſketch of the Mineral Poiſons, a ſubject rendered intereſting by the weakneſs and wickedneſs of mankind. From the vegetable poiſons they are diſtinguiſhable by their action. All the mineral poiſons corrode, ſtimulate, or inflame: the vegetables generally ſtupify, and leave no marks of inflammation. None of the minerals terminate life, till after a moſt excruciating operation of two or three hours at leaſt; whereas ſome of the vegetables deſtroy in a few minutes. From the animal poiſons, the diſtinction is as ſtriking: for although in the plague the mouth and throat are frequently affected in a ſimilar way, yet the local diſeaſe of the ſtomach is never preſent. The aerial poiſons operate ſtill more quickly than either of the other claſſes; and their action on reſpiration is ſo peculiar, that it can never be miſtaken.

When the opinion of a medical man is required on the cauſe of death, in caſes of ſuſpected poiſon, the body ſhould be always ſubmitted to examination; and that he may form a right judgment, the diſſection ſhould take place as ſoon as poſſible after death. There are inſtances on record, where the opinion of a phyſician was required nine days after death. In ſuch caſes it is impoſſible to give a deciſive opinion; all muſt be uncertain. Putrefaction ſo much disfigures parts, that inflammations and gangrenes will *appear*, where they never before exiſted; the blood-veſſels ruptured, the viſcera corroded, the whole body melting away. If putrefaction has commenced, a judicious phyſician ſhould refuſe to perſiſt in the examination: he ought boldly to declare, in ſpight of prejudice and ignorance, that no preciſe information can be gained by diſſection, and that his perſeverance would only open a door to outcry and deluſion. On the contrary, ſuch a man will generally be enabled to pronounce what was the cauſe of death, when the body was opened before any marks of putrefaction were viſible.

With reſpect to judgment of poiſons from their ſymptoms—I think in moſt caſes of mineral poiſons there will be ſufficient ground for a general, and in ſome few, for a particular opinion. When violent pain of the ſtomach ſuddenly comes on, with heat of the throat, trembling, cold ſweats, and faintneſs, they ſhould be always ſuſpected, and the diluent plan immediately purſued.

Againſt vague and unfounded charges of poiſoning, no other inſtruction can be given, than thoſe diſtinguiſhing characteriſtics of poiſons I have before enumerated. By theſe I hope that prejudices will be rectified, and ſuſpicions ſilenced; that to the incautious and miſguided, they will afford a ſhield; but to the dark and malignant aſſaſſin, complete detection.

NOTE.

THE following account of the external application of arſenic in the moſt horrid way imaginable, is copied from Comment. de rebus Lipſiæ, 1793, tom. xxxv. p. 242.

" Ruſticus, prima uxore repentina morte defuncta, brevi poſt ancillæ ſuæ nupſit, poſt paucos annos aliam ancillam impregnavit, hujuſque a cognatis incitatus, uxori ter arſenicum præbuit, quæ tamen effectum ejus poto multo lacte fregit: ſequenti anno, mane quodam poſt coitum a cognato ancillæ ſubminiſtratum & ab hac farina mixtum in illius vaginam digito immiſit arſenicum, unde ea mox ægrotavit & ſequenti die occubuit. Hinc ſceleratus cum ancilla iſta conjugium iniit, infelix autem, ideoque eam ſimili modo tollere conſtituit; hæc vero necis prioris conſcia, quum octava poſt coitum hora inopinato et perdurante horrore, frigore, et urente vaginæ dolore corriperetur, facinoris confeſſionem et auxilia a marito extorſit, verum irrita, morte nimirum, lacte licet interne et externe adhibito poſt vomitus fere continuos, et deliria, elapſis 28 ab applicatione veneni horis ſubſequuta. Sectio monſtravit abdomen non tumidum, nullas in cute maculas, labia vulvæ magna paullum tumida et rubra,

bra, in vagina patula flaccida, pauca grana arſenici chryſtallini, os uteri ſphacelatum & apertum, corpus ejus naturale, ventriculum fere ſanum, duodenum inflammatum multaque bile perfuſum pulmones lividos fere nigros, in utroque cordis ventriculo polypos, reliqua viſcera ſana, ſanguinem in omnibus vaſis fluidum & ſolutum. Quo certius judicium ferre poſſet collegium medicum cl. Abildgaard duas equas ſimili experimento ſubjecit; ſingulæ bolum in arſenici ʒß. cum melle uſque ad os uteri intrudens, altera ſucceſſive injectionibus multæ aquæ tepidæ, olei lini, ſolutionis ſaponis albi in aqua tandemque aquæ vegeto-mineralis reſtituta poſt biduum; altera ſibi ipſi relicta quarto die mortua, cujus ſub ſectione, genitalia & veſica urinaria inflammata & ſphacelata, plurimæ corporis partes inflammatæ." &c.

Acta Reg. Soc. Med. Havniens, t. iii. p. 178.

Note on the diſeaſes of Gilders.

" NEAR two years ago I was firſt diſordered by my trade of button-gilding, from which I experienced the following ſymptoms. — Firſt, I was attacked with a violent pain in my head, which at intervals has continued ever ſince. Upon this

ſucceeded a great dimneſs of my eyes, ſo as to render viſion very imperfect and troubleſome, and which now remains upon me as heretofore. Thirdly, followed a tremulous or convulſed motion throughout my arms, legs, and thighs, ſo as to render me incapable of walking with ſafety without an aſſiſtant. From theſe circumſtances I am now unable to continue my buſineſs."

This is the unaided account of a gilder himſelf, who deſcribes what he felt. It is an exact copy of a letter which he wrote to a phyſician, ſoliciting advice.

NOTE.

The following rules for deciding from the ſymptoms, whether a perſon be poiſoned or not, are tranſlated from Faſelius, by Dr. Farr.

1. FROM comparing the ſymptoms that preſent themſelves, with thoſe which generally attend the taking of poiſons.

2. From the ſudden appearance of ſome ſymptoms, ſuch as ſpaſms, violent pains, great thirſt, ſickneſs, vomiting, fainting, cholic, the throwing

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up ſome foreign matter, from the general contents of the ſtomach, and univerſal convulſion of the muſcles.

3. From the health of the patient foregoing this attack, and his not having had any connection with a perſon labouring under any contagious or epidemic diſeaſe.

4. From the patient having committed no errors in diet, &c.

5. From an ugrateful odour and taſte of what has been taken.

THE END.

ERRATA.

PAGE 6. Note—*for* Veneu *read* Venen. P. 7. l. 24—exiſt—exiſts. P. 11. l. 3 *from the bottom*—Burgman—Bergman. P. 20. l. 6—gas—acid. Ib. l. 16—more—little leſs. P. 21. note—Hiſtory—Hiſt. P. 22. l. 11. note—Mithridate and Theriac—Mithridates and Theriacs. P. 23. l. 7—patient's—patient on his. P. 28. l. 7—internal—external. P. 29. l. 5 *from the bottom*—cicumſtances—circumſtances. Ib. l. 2—have—leave. P. 32. l. 3—Veneris—Venenis. P. 33. l. 7—any—many. P. 35. *laſt line*—are—is.